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Transboundary Fisheries Management Plan for the Cubango-Okavango River Basin

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This publication was prepared for review by the United States Agency for International Development. It was prepared by Dennis Tweddle and Clinton J. Hay of the Community Conservation Fisheries in the Kavango/Zambezi Transfrontier Conservation Area Project funded by the Namibia Nature Foundation and the European Union.

SAREP TECHNICAL SERIES – VOLUME 2A

TRANSBOUNDARY FISHERIES MANAGEMENT PLAN FOR THE CUBANGO-OKAVANGO RIVER BASIN

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OKACOM

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The proposal for the transboundary management plan was developed during a training workshop for members of the three countries' fisheries departments at the Kamutjonga Inland Fisheries Institute (KIFI) in April 2012. The workshop was jointly held by SAREP and the Integrated Co-Management of the Zambezi/Chobe River Fisheries Resources Project run by the Ministry of Fisheries and Marine Resources (MFMR), Namibia Nature Foundation (NNF), and the Worldwide Fund for Nature (WWF). The co-management project supported the contributions of the authors to that workshop. Following that project's completion, the follow-up NNF/EU Community Conservation Fisheries in the Kavango/Zambezi Transfrontier Conservation Area (KAZA) Project continues to support the management plan. The February 2012 Windhoek workshop was attended by Tor Næsje and Odd Terje Sandlund of the Norwegian Institute for Nature Research (NINA), who are developing joint research programs for the fish and fisheries of the region with the University of Namibia, now the employer of Dr. Hay. These collaborative research programs will support the aims of the management plan.

The South African Institute for Aquatic Biodiversity continues to support fish and fisheries research on the Okavango system and was represented in the current program by Paul Skelton, who contributed to the February and May 2013 workshops. The river's ecotourism sector was represented at these workshops by Mark Paxton of Shamvura Camp, who provided constructive inputs to the process. The development of the plan benefited from reports written by, and discussions with, Tom Shipton and Peter Britz of the Rhodes University Department of Ichthyology and Fisheries Science, who recently assisted the Botswana Fisheries Division with proposals for the establishment of a fisheries management plan for Botswana's Okavango Delta.

ACRONYMS

AECB	Association of Environmental Clubs of Botswana
BDF	Botswana Defense Force
BVC	beach village committee
CPUE	catch per unit effort
CBNRM	community based natural resources management
CBO	community based organization
CORB	Cubango-Okavango River Basin
DEA	Department of Environmental Affairs, Botswana
DoT	Department of Tourism, Botswana
DWMPC	Department of Water Management and Pollution Control, Botswana
DWNP	Department of Wildlife and National Parks, Botswana
EU	European Union
EUS	Epizootic Ulcerative Syndrome
FAO	Food and Agriculture Organization of the United Nations
FPA	Fish Protection Area
GEF	Global Environmental Facility
INIP	Angola Ministry of Agriculture's National Institute of Fish Research
IRDNC	Integrated Rural Development and Nature Conservation
JPCC	Joint Permanent Commission of Cooperation between Botswana and Namibia
KAZA	Kavango/Zambezi Transfrontier Conservation Area
KIFI	Kamutjonga Inland Fisheries Institute
KOAR	Kavango Open Africa Route
MEWT	Ministry of Environment, Wildlife and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MINAMB	Angolan Ministry of Environment's Institute of Biodiversity
MPA	Marine Protected Area
NBSAP	National Biodiversity Strategy and Action Plan, Angola
NGO	non-governmental organization
NINA	Norwegian Institute for Nature Research
NNF	Namibia Nature Foundation
NORAD	Norwegian Agency for Development Cooperation
OBSC	Okavango River Basin Steering Committee
ODMP	Okavango Delta Management Plan
OFA	Okavango Fishers Association
OFMC	Okavango Fisheries Management Committee
OIE	World Organization for Animal Health
OKACOM	Permanent Okavango River Basin Water Commission
OKMCT	Okavango Kopano Mokoro Community Trust
OkBMC	Okavango Basin Management Committee
ORI	Okavango Research Institute, University of Botswana
SAIAB	South African Institute for Aquatic Biodiversity
SADC	Southern Africa Development Community
SAREP	Southern Africa Regional Environmental Program
TDA	Transboundary Diagnostic Analysis
UNAM	University of Namibia
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VDC	Village Development Committee
WHC	Water Utilities Corporation, Botswana
WWF	Worldwide Fund for Nature

EXECUTIVE SUMMARY

The Transboundary Fisheries Management Plan for the Okavango Basin aims to establish a joint management system to ensure the conservation and sustainable use of the shared fish resources of the Cubango-Okavango River for the benefit of local communities. The basin — which spans 260,000 square kilometers of southern Angola, north-eastern Namibia, and north-western Botswana — is a biologically diverse ecosystem that supports the livelihoods of more than one million people. Many of them are women, children, and the rural poor. Unsustainable commercialization threatens some Okavango fisheries, as does use of illegal, destructive fishing methods such as light attraction, poisons, explosives, and dragnets.

In the Okavango Delta, fish stocks are in general lightly exploited, with abundance most closely linked with variations in scale of the annual flood. In the Panhandle, on the north-western side of the Delta, stocks are exploited by tourist recreational anglers and commercial fishers, resulting in disagreements about optimal use of the resources. The stocks remain healthy but with potential for localized depletion. In Namibia, the Mahango Core Area of Bwabwata National Park provides full protection for fish stocks, resulting in near pristine populations that have been reported (in the early 2000s) as five times greater than in more heavily exploited areas further upstream in Namibia. These differences have likely increased further as exploitation rates upstream in Namibia and Angola are undocumented but almost certainly rising.

To address the complex issues of managing transboundary watersheds, the fisheries management plan team began with a review of relevant literature and consulted with stakeholders ranging from international and transboundary organizations to national fisheries departments, research institutes, and community fisheries organizations. The literature review covered frame survey[1] reports from across the basin, fish biology and population ecology monitoring reports and scientific papers, and local, national, and international regulations, policy, and legislation. A fourth category was added during the literature review itself: socio-economic and tourism studies. Despite several socio-economic studies from Botswana, there is as yet no clear path for maximizing the considerable benefits of angling tourism to local communities. It remains one of many contentious issues to be resolved.

This management plan is presented in two parts. Part A presents information used in developing the plan, while Part B details the activities to be carried out under it.

Achieving the goal of the plan — responsible co-management of shared fish stocks — will require securing information on the yield and harvesting patterns used by subsistence and commercial fisheries, biological and biodiversity data of fish populations, and institutional linkages between scientists in Angola, Namibia, and Botswana. The plan sets up mechanisms to secure buy-in from all sectors for cooperation in management of fishery resources. Highlights include:

[1] According to FAO's "Sampled-based fishery surveys. A technical handbook" (http://www.fao.org/3/a-y2790e.pdf) A Frame Survey collects data on all fishing vessels and gear which could be potentially operating within the area of interest and which can provide information including fishing trip patterns, seasonal use of fishing gear and socio-economic and demographic data for fishing communities.

Harmonizing policies and law enforcement. Intergovernmental dialogue, which is continuing with support from the Southern African Regional Environment Program (SAREP), has led to progress on a number of fronts. But more attention is needed on prohibited fishing gears; intentional or unintentional introduction of exotic or alien fish species; closed seasons; transboundary agreement on gillnets, particularly between Namibia and Angola; fishing license regulations; fishing councils as forums for government agencies to interact with fishers; mesh size regulations; and reserves or protected areas. Law enforcement, such as joint patrols by Namibia and Angola, will also need to be coordinated through agreements established by this management plan. Annex 3 presents a comparative table of regulations in the three countries.

Strengthening research and monitoring. Currently, data collection differs between the three countries due to different policy approaches, financial and manpower resources, infrastructure, and experience of fisheries scientists. The transboundary research and monitoring programs proposed in this plan will greatly improve knowledge of fish stocks by comparing results in areas of varying exploitation rates throughout the system. They will also create opportunities to attach postgraduate students to regional fisheries research projects, enhancing capacity building within each government department. Useful longitudinal databases, of course, require that research gaps first be identified and a coordinated, long-term monitoring system be developed.

Empowering community-led management. Communities need to be fully informed of fisheries issues, from basic fish biology to regulations. This will entail environmental education for all residents, from schoolchildren to elders. Fisheries committees should be set up, but only after careful and detailed consultation with all stakeholders. Although these committees should be formed or elected by communities themselves, it is important to ensure that all community members, particularly fishers, are represented. If the resource is shared by different communities, the process should be structured to ensure all are fully represented on the committee, or that a central coordinating committee composed of key members of separate village committees is established. New groups can learn from already successful ones through exchange visits between communities and other stakeholders. Fisheries departments' role in co-management, then, is primarily education, supporting communities in decision-making, endorsing locally agreed upon bylaws when appropriate, and advising against inappropriate or unsustainable activities.

Establishing fish protection areas. For communities wishing to set aside areas for recreational fishing, governance approaches need to be extended to include reserves — Fish Protection Areas (FPAs). While there has been much discussion of creating separate zones for commercial and tourism angling in the Panhandle, this approach may be too simplistic and likely to result in disagreement, conflict, and flouting of rules. Rather, FPAs should be established where fish are protected and where communities can earn revenue from anglers (practicing catch and release) through payment of rod fees. The main long-term benefit to the communities is improved recruitment of fish to those adjacent areas that are open to fishing, but communities as a whole also benefit financially from the tourist rod fees.

Therefore, joint steering committees shold be established and officially endorsed by all three countries, to:

- Strengthen collaboration and communication on a technical level
- Prepare the budget needed to implement the plan

• Approve the research and monitoring programs to be conducted
• Ensure that collaboration and monitoring programs continue after this project and are sustainable considering future resources and infrastructure

PART A: DEVELOPMENT OF THE TRANSBOUNDARY FISHERIES MANAGEMENT PLAN

OBJECTIVES OF THE PLAN

The aim of the proposed Transboundary Fisheries Management Plan for the Okavango Basin is to establish a joint management system to ensure the conservation and sustainable use of the shared fish resources of the Cubango-Okavango River for the benefit of local communities. The plan will provide a foundation for the responsible co-management of shared fish stocks between Angola, Namibia, and Botswana in the Cubango-Okavango River basin. To achieve this aim, information on the yield and harvesting patterns used by the subsistence and commercial fisheries, biological and biodiversity data of the fish populations and institutional linkages between scientists in Angola, Namibia, and Botswana must be obtained.

The management plan can contribute toward the national capacity of Angola, Namibia, and Botswana to better conserve and manage the fisheries resources of the Cubango-Okavango River. It can also facilitate greater participation of fishing communities in the management of resources upon which they largely depend for food security and income generation, and sustainable development of freshwater fisheries sector in all three countries. The management plan can further act as a catalyst for improving cooperation in management and development of the river with other riparian states that share the resources of the Okavango/Zambezi system, including Zambia and Zimbabwe. Figure 1 below illustrates the geography of the Cubango-Okavango River Basin and the surrounding areas for future collaboration.

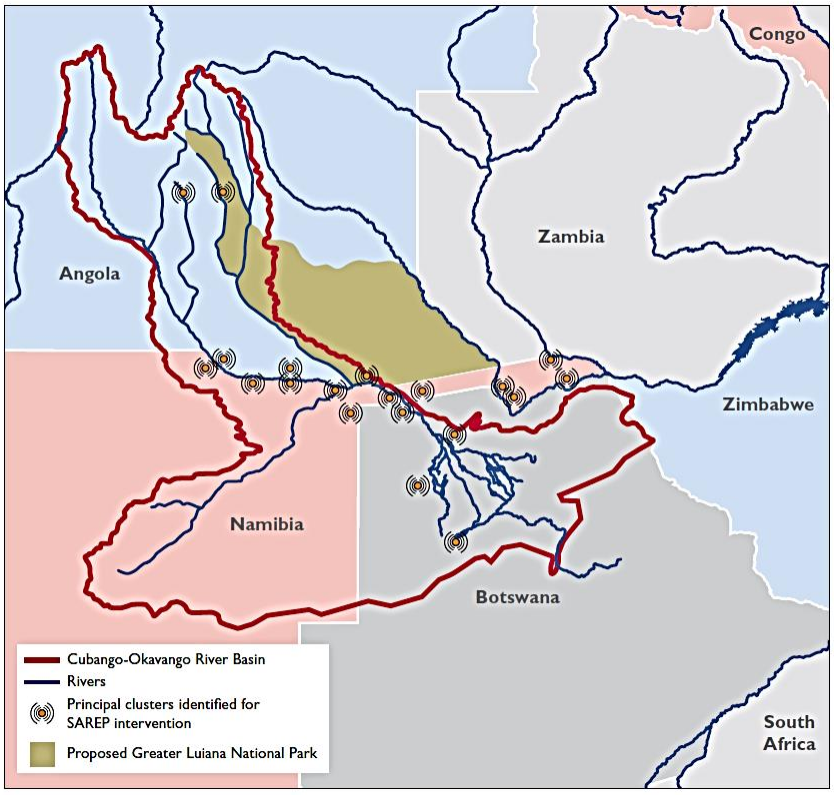

Figure 1: A map of the Cubango-Okavango River Basin and SAREP intervention locations.

The outputs that should be achieved from implementation of the plan (with minor re-arrangement from original proposal) include:

1. Collaboration and communication on a technical level strengthened.
2. Standardized survey methodology adopted in the three countries.
3. Research teams and stations, monitoring activities, capacity building and fisheries training strengthened.
4. Government fisheries staff trained in use of equipment and research methodologies.
5. Database created for storage and analysis of resource information necessary for effective joint management.
6. Data sharing protocol established.
7. System for long-term ecological monitoring of fish stocks established.
8. Longitudinal profile of fish populations fully documented, from the riverine habitats in Angola to the seasonal swamps in the lower Delta in Botswana.
9. Effects of seasonal flood level variations on the fish population dynamics and fish migration, behavior, and habitat utilization of the Cubango-Okavango River Basin determined.
10. Socio-economic importance of inland fish determined, in terms of catches and utilization by subsistence (and small-scale commercial) fishers.
11. The role of possible different management measures for fisheries determined.
12. Co-management regime for Cubango-Okavango River fisheries proposed.
13. Policies and legislation developed and harmonized.
14. Early warning system developed for the outbreak of disease and presence of alien/exotic fish species in the system.
15. Secure support to implement the plan from the nation states.
16. Budget to implement the plan prepared.

In this management plan, we address all outputs in the context of the required tasks provided in the Terms of Reference (see box below).

Fisheries Management Plan Terms of Reference

1. Literature Review
   - Frame survey reports from across the basin
   - Fish biology and population ecology monitoring reports and scientific papers
   - Relevant local, national, and international regulations, policy, and legislation
2. Stakeholder Consultation (see boxes below for lists of stakeholders in each country)
   - International/transboundary organizations
   - National fisheries departments
   - Research institutes
   - Community fisheries organizations
3. Development of Transboundary Fisheries Management Plan
   - Report of survey defining current status of fish populations, fisheries activities, and the implementation of various regulations, acts, and policies within the basin
   - Influence of adjacent basins; collaborations, alignments, and standardization of monitoring activities and regulations
   - Driving forces within the basin affecting fish populations — direct threats, conflicts, and indirect impacts
   - Management interventions: Objectives; Policy harmonization and law enforcement; Co-management models; Fish protection zones; Community awareness; Monitoring activities; frame surveys; biological surveys

Consultation Process

Following a fisheries meeting in Maun toward the end of 2011 — under the auspices of the Joint Permanent Commission of Cooperation (JPCC) between Botswana and Namibia — SAREP was asked to provide training to JPCC on conducting fisheries identification surveys and identifying fish diseases.

Namibia Stakeholders

- Traditional authorities: 5 in Kavango
- Conservancies; 1 on river but 2 others could be extended to include river
- Schools; to form environmental groups
- Fishery committees; none yet in Kavango
- Kavango Regional Council
- Subsistence fishers; some migrant fishers from Caprivi moving in
- Ministry of Fisheries and Marine Resources
- Ministry of Environment and Tourism
- Ministry of Forestry and Agriculture
- Regional and town councils
- NamPol (Namibian Police)
- Immigration
- Ministry of Health; spraying of insecticides along river

A training workshop was therefore organized in April 2012 at the Kamutjonga Inland Fisheries Institute (KIFI), jointly hosted by SAREP and the MFMR/NNF/WWF Zambezi/Chobe Fisheries Project. This initial training program was entitled: "Training/Workshop on Fish Identification, Pasgear, Monitoring and Diseases at KIFI (Namibia)." The key research staff of the fisheries departments of the three countries attended. As part of this workshop, and based on earlier project proposals from the early 2000s, the participants developed the following proposal: "Transboundary Fisheries Management Plan Proposal for the Cubango-Okavango River basin: Toward Responsible Shared Fisheries Management for the Cubango-Okavango River, Angola, Botswana and Namibia, May 2012 (Proposal for the development of the Management Plan)." This document formed the basis for the current consultation process.

With the support of SAREP, key fisheries personnel from all three countries met in Windhoek to map the way forward in developing the full management plan as a consultative process. The workshop report was entitled: "Developing a Transboundary Fisheries Management Plan: Proceedings of a regional fisheries meeting; attended by fisheries officers from Angola, Botswana and Namibia, Windhoek, Namibia; 23rd to the 26th July 2012." The workshop focused on forging links between the fisheries departments and researchers in the three countries for research and monitoring.

Botswana Stakeholders

- Okavango Fishers Association
- Okavango Fisheries Management Committee
- Association of Environmental clubs of Botswana; government-run
- Community-based organizations
- Village development committees
- The Tribal Authority; government structure, not communities per se
- Leadership from traditional authorities in villages
- 5 community-based concessions in the Okavango*
- Kalahari Conservation Society
- BirdLife Botswana
- Basin Wide Forum in Angola, Botswana, and Namibia
- Department of Wildlife and National Parks
- Okavango Research Institute, University of Botswana
- Department of Environmental Affairs
- Department of Tourism
- Water Utilities Corporation
- Tribal Administration
- Ministry of Environment Wildlife and Tourism
- Department of Waste Management and Pollution Control
- Veterinary Services
- Police
- Immigration
- Education
- Botswana Defence Force

* Also have CBOs, e.g., Okavango Kopano Mokoro Community Trust (OKMCT), Poler's trust, Khwai. Each has management of trust and is primary stakeholder of fishery management in these areas. Outside of CBOs, SAREP has focused on village development committees, each of which is a company with one share per village member. Currently, trusts are proposed in other areas, e.g., Lake Ngami.

The discussions in the workshop were broad ranging and emphasized the need to involve all stakeholders in outputs to be developed as proposals in the plan. Two consultants with decades of experience on inland fish and fisheries research and

Angola Stakeholders

There are 27 provincial associations of fishers in Cuando-Cubango, with 768 registered fishers, and a fishers' association with 20 members in Chitembo, Bie. All areas have traditional authorities — chiefs, known as *Sobas* who are undisputed leaders and are key to state or NGO interventions in the villages. There are seven fishery communities: Caiundo, Savate, Kaira, Kuangar, Calai, Dirico, and Mucusso.

- Institute for Development of artisanal Fishery and Aquaculture
- National Institute for Fisheries Research
- National Police (Immigration Service and Boundary Guard)
- Association for Environmental Conservation and Integrated Rural Development
- National Union of Cooperative Associations for livestock and fisheries of Angola
- Provincial Department of Hotels and Tourism
- Agostino Neto University
- Higher Polytechnic Institute
- Veterinary Services
- Provincial Department of Environment
- Luiana Organization
- Technocarro (Tourism)
- Provincial Office of Agriculture, Rural Development and Fisheries
- Provincial Office of Environment and Conservation
- National Union of Agriculture
- Development of Rural Agricultures and Fisheries (National ONG)
- Directorate of Fisheries and Agriculture in the provinces, with Departments of Fisheries
- Education
- Health

management in the region, Mr. D. Tweddle and Dr. C.J. Hay, were tasked with compiling the management plan and ensuring that all stakeholder groups would be fully represented when implementing the management plan.

Terms of reference were drawn up for the consultants to guide the development of the management plan. A scoping/inception report was prepared and circulated to key stakeholders in advance of a scoping workshop held in Windhoek in February 2013; reported in "Developing a Transboundary Fisheries Management Plan, Proceedings of a regional fisheries meeting; attended by fisheries officers from Angola, Botswana and Namibia, 21st and 22nd February, 2013." In addition to fisheries staff, this meeting was attended by Mr. M. Paxton to represent the tourist lodge sector, Dr. P.H. Skelton because of his knowledge of the fish fauna including the Angolan upper reaches, and Norwegian scientists who have, in the case of Dr. T. Næsje in particular, extensive knowledge of the fisheries of the Namibian sector of the river.

For the scoping process, the consultants posed a series of questions that needed to be addressed during the workshop in order to inform the management plan. The results of those discussions were included in the proceedings. The key component of these proceedings is the list of stakeholders that will be involved in consultations during the implementation of the management plan. (See boxes above.)

Following the scoping process, the consultants developed a draft of this management plan, which was circulated to key stakeholders in advance of a final workshop to review the draft.

This was held in Rundu, Namibia, on 7th May. Suggestions and comments from the participants of that workshop have now been incorporated into this final management plan document.

LITERATURE REVIEW

Literature was obtained covering the three topics listed in the TOR but adding a fourth topic, i.e., the important role of socio-economic and tourism studies:

1. Frame survey reports from across the basin
2. Fish biology and population ecology monitoring reports and scientific papers
3. Socio-economic studies, including tourism
4. Relevant local, national, and international regulations, policy, and legislation

As far as the authors are aware, the great majority of scientific papers and reports on the Okavango fish and fisheries have been examined to ascertain their relevance to the development of the Fisheries Management Plan. A full reference list is included here.

The first major research program on the Okavango Delta was initiated in the 1980s with a Ph.D. study by G. Merron of the JLB Smith Institute of Ichthyology (now SAIAB) that highlighted the importance of the annual floods in fish production (Merron, 1991, Merron and Bruton, 1988).

Prior to this major study there were only a few reports of limited scope (Dibbs, 1965; Hall, 1971; Maar, 1965; Fox, 1976; Gilmore, C., 1979a, b; Gilmore, K.S., 1976, 1979).

Merron and his JLB Smith Institute colleagues were the first scientists to emphasize the diverse nature of the riverine and floodplain fish fauna and highlight the possibility of expanding exploitation to the smaller species in the system, particularly the silver catfish, Schilbe intermedius. Numerous reports were produced during this research program, covering fish ecology, species distribution, fisheries recommendations, potential impacts of the National Water Carrier on fish distribution, effects of tsetse fly spraying, etc. (Merron, 1987a,b, 1991; Merron and Bruton, 1984a,b, 1988, 1990, Merron et al., 1984a,b, 1985; Skelton and Merron, 1984, 1987; Skelton et al., 1985). In addition many scientific papers were published (Booth and Merron, 1996; Booth et al., 1995; Booth and McKinlay, 2001; Merron, 1992, 1993a, 1993b; Merron and, Bruton, 1995; Merron and Mann, 1995; Merron et al., 1990).

More recently, research on fish ecology and fisheries potential continued and has been expanded to include the social and economic aspects of fisheries and their development.

In Botswana, research was and is conducted by K. Mosepele and his colleagues in ORI and the Fisheries Section (Bokhutlo, 2011; Kgathi et al., 2005; Mmopelwa et al., 2005, 2009; Mosepele, 2000, 2001; Mosepele and Kolding, 2003; Mosepele and Mosepele, 2006; Mosepele and Nengu, 2003; Mosepele and Ngwenya, 2010; Mosepele et al., 2003, 2005a,b, 2006, 2009, In prep.; Nengu, 1995; Ngwenya and Mosepele, 2007, 2008; Ramberg et al., 2006; Siziba et al., 2011). The dynamic nature of floodplain fisheries has been repeatedly stressed in many of these publications. The concept of maximum sustainable yield is largely irrelevant in this floodplain fishery with its complex mosaic of habitats and areas of relative inaccessibility, where the main driver in fish production is the size of the flood pulse, but

where fish availability and catchability is highest when discharge rates are at their lowest, through a 'concentration' effect (Mosepele et al., in prep.). The fish production/flood pulse relationship is common in numerous other African river fisheries (Welcomme, 1985, 1991) including other Zambezian floodplain fisheries (Tweddle et al., 1995). Other recent topics of fish-related studies have been genetic diversity and taxonomy (Kramer et al., 2003; 2007, 2011, 2012; Soekoe et al., 2009; Van der Bank and Smit, 2007; Van der Bank et al., 2009) and parasites (numerous papers by J. Van As and colleagues, e.g., Basson and Van As, 2002; Christison et al., 1998, 1999a, 1999b, 2001, 2005; Moravec and Van As, 2001, 2004; Reed et al., 2002; Smit et al., 2000, 2003, 2004)

Social and economic issues are of major importance in the Okavango fishery, with conflicting expectations of subsistence, commercial, and tourism angling interests, mainly in the Panhandle region of the river in Botswana (Nengu, 1995; Bills, 1996; Tweddle et al., 2003; Ramberg and van der Waal, 1997; Ngwenya and Mosepele, 2008; Mosepele and Ngwenya, 2010). These issues are covered thoroughly in the documentation for the draft management plan for the Okavango Delta in Botswana produced by Shipton (2011), particularly in the reports on stakeholder workshops. In all of the published information on the perceived conflicts between different stakeholder groups, there has been a tendency to present the conflicting interests in terms of "either/or." Although the Biokavango program succeeded in bringing stakeholders together to develop a Code of Conduct for responsible fishing in the Delta, and initiating a pilot fishing-free zone (Biokavango Project, 2011a,b), there is considerable scope to investigate alternative scenarios for resource sharing that provide benefits for all stakeholders. The scope for Fish Protection Areas (FPAs), equivalent to the well-established concept of Marine Protected Areas (MPAs) should be considered rather than the widely discussed and controversial idea of separate zoning of recreational and commercial fishing areas that dominates the discussions in the documentation reviewed by the authors of this management plan (Bills, 1996; Tweddle et al., 2003; Setswalo, 2007; Shipton, 2011), although Shipton (2011, p. 39) recognizes that if zoning of recreational fishing areas is to be successful it is essential that affected communities are empowered to benefit from the recreational fishery, e.g., in terms of employment opportunities.

In the Caprivi floodplain on the Zambezi River in Namibia, pilot FPAs identified and established by fishing communities are proving to have the potential to boost stocks for the benefit of the fishers as well as earn revenue for the communities as a whole through income from angling tourism (Tweddle and Hay, 2011b). These pilot FPAs may form a model for the establishment of similar protected areas on the Okavango River. The establishment of FPAs is strongly encouraged elsewhere in the world e.g., Suski and Cooke (2007). Cooke et al. (2006) discussed compatibility between catch-and-release recreational angling and marine protected areas, and stated that "research in the field of catch-and-release is beginning to show that certain handling techniques can significantly reduce post-release mortality in fish. With appropriate regulation and angler education, catch-and-release could help enhance conservation and management goals associated with MPAs while maintaining public support and providing alternative tourism-based revenues for displaced fishers."
In Brazil, Lopes et al. (2011) reviewed the variety of systems of management, co-management, and reserves in the Amazon and also coastal fisheries, and discussed systems of management of natural resources as a whole, including use of "two categories of fisheries co-management in Brazil: Extractive and Sustainable Development Reserves." They stated that the inhabitants of coastal reserves can rely on ecotourism and jobs outside the reserves, which may reduce local fishing pressure. Such reviews of successes and failures of co-management

elsewhere in the world should be used to inform such initiatives developed through the implementation of the current management plan.

There is also scope for integrating FPAs with other protected areas created for other conservation targets. In Namibia, Mahango National Park creates a no-fishing zone on the Kavango river at the Namibia-Botswana border. Between 1992 and 1999, experimental catch rates within the park were approximately five times higher than in heavily-exploited areas upstream (Hay et al., 2000). This park benefits fisheries on either side of the park and of the international border through improved recruitment from the park. In Botswana, a proposal has been made to establish the Phillipo Channel as a protected area for crocodiles during their breeding season (Okavango Crocodile Monitoring Programme, 2011). The proposal also highlights the importance of this channel for birdlife, particularly African Skimmer, Pels Fishing Owl and White Backed Night Heron. Establishment of the channel as a protected area would provide protection for 43 percent of crocodile breeding areas in the Panhandle, and would not interfere with transport through the main Okavango Channel. The channel is reportedly distant from the main commercial fishing concerns, and thus establishment of the Phillipo Channel as a more comprehensive protected area for all aquatic fauna and flora is a realistic goal to be considered as a target in this management plan.

In Namibia, Hay (1995) conducted research on the Okavango River fisheries using mainly gillnets as the sampling method, and developed a database for the assessment of biotic integrity, while Hay et al. (2000) made detailed recommendations on sustainable utilization of the fishery, recommendations that are largely endorsed in the current (2003) Inland Fisheries Resources Act and associated regulations, and in the formulation of this management plan. New biological research results on the age and growth of the important commercial and recreational fishing species are also available (Peel, 2012; Peel et al., 2012) and have contributed to recommendations for modifications to the Inland Fisheries Resources Act and regulations (Tweddle and Hay, 2011a).

Frame survey reports are available for Botswana in 2005 (Bokhutlo et al., 2007) and Namibia in 2010 (Munwela, 2010), but no comprehensive frame survey has yet been conducted in Angola.

In Angola, biodiversity survey results are now available (Brooks, 2012; Bills et al., 2013). The biodiversity survey added several new species to the known Okavango fish fauna (Skelton, 2001, Tweddle et al., 2003). In addition, recent name changes and recognition of other undescribed species in Namibia and Botswana are not yet reflected in the literature.

All government policy and legislation documents have been compiled for consultation in developing the management plan, and to review in terms of harmonization of policies and regulations across the three countries, not only for fisheries but also for tourism (Government of Botswana, 1975. 1990, 2002, 2008, 2010a, 2010b; Government of Namibia, 2003a,b; ODMP, 2007). In addition, there are several contributions to planning and management processes by other organizations (Biokavango Project, 2011a,b; S. Thapelo Attorneys, 2008). A diagnostic analysis by Shipton (2011) of the legislative and institutional frameworks for the Okavango Delta in Botswana is discussed below. In Namibia, Kavango River fisheries are managed through the Inland Fisheries Resources Act of 2003 and associated regulations (Government of Namibia, 2003a,b). Recommendations for amendments are discussed below. In Angola, the inland fisheries are regulated through the "Regulamento Geral da Pesca, Decreto No 41/05 of 2005" under the Aquatic Biological Resources Act of 2004, i.e., "Lei

dos Recursos Biologicos Aquaticos, (Nova Lei as Pescas), (Publicada no Diário da República No 81, I Série, Suplemento), Assembleia Nacional, Lei no 6-A/04."

Synopsis of Issues Arising From Review of Literature

Frame Surveys

The main purpose of any fishery frame survey is to provide a comprehensive picture of the extent of a fishery, i.e., a detailed inventory of all the fishing craft and fishing gear. A frame survey should provide a complete description of the structure of any system to be sampled for collection of statistics. In fisheries, it may include the inventory of ports, landing places, number and type of fishing units (boats and gear), and a description of fishing and landing activity patterns. This information then provides the "frame" with which catch statistics collected from a sample of fishers can be used to estimate catches from the fishery as a whole by extrapolation (e.g., Bazigos, 1972; FAO, 1998). Typically, such frame surveys are also used to gather socio-economic data on the state of the fishery and information on issues such as fish distribution routes, processing and marketing patterns, supply centers for goods and services, etc.

Namibia. The frame survey of the Kavango River in Namibia reported on by Munwela (2010) covered 28 villages and 1,065 fishers, and according to C. Munwela (pers. comm.) covered the great majority of villages from which fishers operate. This report provides a very useful survey of communities along the Kavango River, their fishing activities, and their knowledge, or lack of it, about fishery regulations and management. It does not, however, fulfill the criteria for being a comprehensive frame survey that would allow a full statistical analysis to be derived from sample catch recording.

Botswana. The last frame survey conducted in Botswana took place in 2005 (Bokhutlo et al., 2007). Prior to that, a survey was carried out by the Fisheries Division in 1997 (Mosepele, 2001) across nearly all fishing households around the Okavango Delta and estimated 3,243 fishers. An attempt was also made to quantify the type of fishing equipment used to catch fish and how the use of such equipment varied with seasons.

The 2005 study was conducted in 16 villages in the Northwest District which are in the periphery of the Delta within the newly proposed boundaries of the existing Okavango Delta Ramsar site. Villages covered were: Ditshipi/Daunara, Boro, Maun, Gumare/Tubu, Etsha villages, Ikoga, Sepopa, Nxamasere, Shakawe, Mohembo, Kauxwi, Xakao, Ngarange, Mogotlho, Seronga and Gunitsoga. (These are the main fishing villages and they are also composed of small settlements).

The report emphasized flaws in data collection and therefore reported that data collected directly from fishers are of little help to the Fisheries Division.
The survey findings indicated that there was a total of 2703 fishers in the Okavango, the majority of whom (52 percent) were women. Only 3 percent (85 fishers) were commercial, with 97 percent purely subsistence. Of the 957 boats reported, 80 percent were dugout canoes (makoros) the rest being aluminum and fiberglass boats. A significant amount of the boats were used for transport rather than fishing, with 59 percent reported as being used for fishing. Knowledge of fishing regulations was reported to be very low throughout.

The Okavango Delta Management Plan (ODMP, 2008) is a 216 page document, which includes in its text the following (in text box) extremely limited information on fisheries, perhaps reflecting the very low priority still placed on fisheries by the Botswana Government. With such limited surveys, and the unrealistically low estimates of annual catch from the Delta (~160 t.yr-1), this is not surprising. With approximately 3,000 fishers in the system, one might expect annual yields several times greater than estimated.

3.3.6 Fisheries (from ODMP, 2008)

There is limited information on the Okavango fish stocks and this has resulted in uncertainties in the management of fish resources.

The overlap of commercial fishing and angling/ recreational activities on the same fishing grounds have often resulted in conflicts.

The only piece of fisheries legislation that exists is the Fish Protection Act of 1975, which is very outdated. The Okavango Delta fishery is still an open-access fishery with no regulatory mechanisms in place.

Fish Biology and Population Ecology

The most comprehensive study on the biology and populations of the fishes of the Okavango system was the Ph.D. study of Merron (1991), which resulted in the numerous reports and scientific papers listed in the introduction to this section. Merron's study included the reproductive and feeding biology of the important fisheries species, together with a comprehensive review of the overall floodplain ecology and the seasonal response of fish communities to the annual flood regime, including fish species distribution in relation to habitat. This study remains the definitive study on the ecology of the fishes of the Okavango Delta.

Follow-up studies have concentrated on fisheries stock assessment (Mosepele, 2000 and other papers listed above), based primarily on length-based assessments. Length-based stock assessment models were developed for use in fisheries where limited biological data are available on the species, but should not be considered as a substitute for detailed biological and ecological research, particularly age and growth studies.

In Namibia, a comprehensive sampling survey was conducted between 1992 and 1999 at selected sites along the length of the river (Hay et al., 1996, 1997, 2000; Hocutt et al., 1994). Species composition of catches of research nets, abundance indices, length frequencies, and biological parameters of the most important fisheries species were all determined. The report is particularly notable for the evidence it presents on the difference between catch rates in unfished and heavily exploited areas of the river.
A survey of the fisheries activities on the river was then conducted by Munwela (2010). This study also presented length frequency and cpue data for the commoner species in research nets.

More recently, the first reliable estimate of growth rates of the most important commercial cichlid species was conducted (Peel, 2012; Peel et al., 2012), using analysis of annual rings laid down on otoliths. The fish used in this study came largely from the downstream stretch of the river just above the Namibia/Botswana border, and can therefore be considered representative of fishes in the upstream part of the river in Botswana also through the Panhandle section where the main commercial fishery operates.

The estimates of growth rate generated from the length-based stock assessment are unrealistic, particularly for the important threespot tilapia, Oreochromis andersonii, due to the limitations of assessment from research gillnets. For this species, for example, estimates of growth for O. andersonii in the first year ranged from 12 cm (Mosepele et al., 2006) to nearly 40 cm (Mosepele, 2000). The more realistic figure is in the range 15-20 cm (Peel, 2012) and

length only approaches 40 cm after five years. With the new information on growth rates of the important commercial species, which differ from the estimates generated by the previous length-based assessments, it is important that the yield assessments are reviewed as part of the outputs stemming from this management plan.

The biology of the clariids in Botswana was studied by Bokhutlo (2011), who used otoliths to determine growth rates, determined the size at maturity, and concluded that the stock in Botswana was only lightly exploited.

Social and Economic Studies

In Botswana, Mosepele et al. (2006) reported on artisanal fishing in relation to food security in the Delta, while Ngwenya and Mosepele (2008) reviewed the socio-economic status of subsistence fishing and Mosepele and Ngwenya (2010) reviewed the commercial fishery. The value to the local economy of the angling tourism industry has not, however, so far been accurately assessed despite the recommendations of Tweddle et al. (2003), which also addressed the need to understand the other components of the fishery.

The studies that have been conducted have revealed the vital importance of the fisheries for livelihoods of the communities along the river system.

The subsistence fishing study (Ngwenya and Mosepele, 2008) showed that fishing is a source of income for about 40 percent of the households sampled and contributes about 30 percent of the total median income. It is also noteworthy that the majority of subsistence fisher families in the Delta are single parent households headed by a female, which highlights the vulnerability of the subsistence fisher households in the Delta. Cash earned from the sale of fish is mostly used for such daily necessities as food, toiletries, and clothing.
The commercial fishery has varied in extent and in efficiency over the years with a most recent estimate of 85 commercial fishers (Bokhutlo et al., 2007). Mosepele and Ngwenya (2010) provided a comprehensive review of the contribution of the fishery to local livelihoods. Unlike in Namibia, where Mahango National Park yields experimental catch rates five times greater than exploited areas (Hay et al., 2000) , the papers of Mosepele and his colleagues report no evidence of impact of fishing on the resources. Despite this, Mosepele and Ngwenya (2010) report intense resource user conflicts during the low water period. The conflicts that do exist are clearly not a result of overfishing, but of competition for the same resources in the same areas.

To date, no major study appears to have been made of the contribution of the tourism lodges to the local economy in the fishing areas, an observation also noted by Shipton (2011). Shipton gave an example from just one of the five fishing lodges in the Panhandle area. In 2010, receipts for accommodation for fishing tourists totaled approximately 2.4 million Botswana pula (BWP), with a further 680,000 BWP earned from fishing boat hire fees. The establishment employs 35 people (with dependants, estimated at seven to ten per family head by Mosepele and Ngwenya (2010), this equates to ~250-350 people) with an annual wage bill in the region of 1 million BWP. A study of fishing lodges in a similar recreational fishery on the Caprivi floodplain on the Upper Zambezi showed the considerable contribution fishing lodges made to the local economy in terms of employment (Sweeney et al., 2010).

Promotion of tourism is, however, not without problems. Ad hoc development of facilities and allocation of exclusive rights over use of natural resources to tourist companies without

regulation through a comprehensive national policy can lead to problems (Mbaiwa, 2002) and conflicts with local communities. Mbaiwa (2002) criticized the way in which tourism has developed in the Okavango Delta area and highlighted several areas of concern, e.g., (1) management positions filled from outside while local community members are restricted to low paying menial positions, and unfair pay differentials between locals and outsiders when occupying similar posts; (2) inadequate control of external revenues and taxation; and (3) unlawful exclusion of local community members from use of traditional natural resources. It is also evident that, as in any industry and human endeavor, there is considerable variation in the quality of relationships between tourism lodges and local communities. While all these issues need to be addressed, they should not detract from the considerable potential of angling tourism to bring financial and infrastructural benefits to the local communities, whether directly through employment or indirectly through further investments in the local economy. Maun would not exist as a town in its present form without tourism investment, and similarly Kasane on the Chobe River is entirely focused on tourism.

In Namibia, Munwela (2010) reported on the profile of people engaged in fishing activities. He noted that 60 percent of the fishers interviewed were female, with fishing being an obvious and convenient method of feeding their families. As in Botswana, therefore, subsistence fishing is a major contributor to local livelihoods. Recognizing this, Namibian fisheries policy discourages commercialization of the resources, following the recommendations of Hay et al. (2000). In the Kavango Region of Namibia, tourism is an important and growing source of employment for the local communities.
Literature on the Angolan Cubango fisheries is limited, and we are indebted to Francisco Almeida (pers. comm.) for information on the current status. The fishery is predominantly for subsistence using various kinds of fish traps together with small-meshed (37 and 40 mm) gillnets, hook and line, and mosquito nets. Subsistence fishing is an important activity for women and children. There are some exceptions where government support is being provided in the form of nets and fishing vessels, documented under stakeholders later in this report. Fishers depending entirely on fishing often spend long periods away from home when they follow fish migrations or concentrations. The region of the Cubango River and tributaries in Angola is home to 3,000 people.

Regulations, Legislation, and Policy

Shipton (2011) reviewed the legislative and institutional frameworks for the Okavango Delta in Botswana, and it is therefore unnecessary to elaborate on the issues here. Instead, it is included (with adaptation and some abbreviation for consistency in presentation) as Appendix 1 to this management plan.

In Namibia, Kavango River fisheries are managed through the Inland Fisheries Resources Act of 2003 and associated regulations (Government of Namibia, 2003a,b). Recommendations on amendments to these regulations, aimed at empowering fishing communities to take a greater role in management in partnership with the MFMR, were put forward by Tweddle and Hay (2011a). These recommendations primarily include recognition of the important role conservancies can play in management. Their absence from the existing act and regulations is a reflection of the rapid establishment and spread of conservancies empowered to manage their own natural resources throughout Namibia since the act was promulgated. Wherever the act recognizes traditional authorities and regional councils, Tweddle and Hay (2011a) have recommended including recognition of conservancies. There is also a need to empower communities to establish bylaws in partnership with MFMR,

where fishery activities can legitimately be allowed that are not covered under existing regulations. A review of the act and regulations is currently underway by MFMR.

In Angola, the inland fisheries are regulated through the Aquatic Biological Resources Act, i.e., "Regulamento Geral da Pesca, Decreto No 41/05." Relevant sections of the act are included in Appendix 3 of this management plan, where harmonization of the acts and regulations in the three countries are reviewed.

STAKEHOLDER CONSULTATION

International/Transboundary Organizations

The Okavango River and its natural resources have attracted interest from numerous NGOs and other organizations in recent decades. Their contributions include:

IRDNC

In Namibia, the NGO Integrated Rural Development and Nature Conservation supports and provides training to conservancies in Namibia for natural resource management. It cooperates closely with NNF and WWF in fisheries management initiatives in Caprivi. IRDNC has a potential role in the management plan in Namibia to strengthen conservancies' participation in fisheries management.

Kavango Open Africa Route (KOAR)

KOAR has developed and is now engaged in promoting a Kavango tourism route as part of the southern African NGO Open Africa (www.openafrica.org), whose vision is "Open Africa offers travellers a network of authentic, life enriching journeys across Africa, while enabling livelihoods and enhancing conservation." The tourism operations are committed to the health of the river ecosystem and the well-being of the riparian communities. They are entirely open to assisting in any way possible with the sustainable management of this system. The tourism operators have long-term commitments and responsibilities, with a range of resources and expertise available to support the fisheries departments in implementation of agreed management interventions. A submission by KOAR on the tourism viewpoints is included as Appendix 2 to this document.

KAZA

The Kavango/Zambezi Transfrontier Conservation Area (KAZA) is a major transboundary natural resources management program encompassing large areas of the Zambezi river system in addition to the Okavango River, with governments as the major partners. The organization is still very much in its initial development stage, and fisheries are assuming increasing importance in addition to the initial terrestrial mammal emphasis. KAZA is seen as potentially a major partner in any fisheries management programs in the region.

NNF

The Namibia Nature Foundation led the Zambezi/Chobe Transboundary Fisheries project and the new EU-funded project for fisheries co-management in the region. This Okavango transboundary management plan development forms part of the close coordination that has developed between SAREP and NNF.

The EU project, short title "Community Conservation Fisheries in KAZA Project" has the potential to be a major partner in the implementation of this management plan. Partnered with ORI, the project's aim is to "Strengthen community-based management of river and floodplain fisheries in Namibia, Zambia, and Botswana, contributing to environmental conservation and to improve socio-economic benefits and food security, especially for women, children and the rural poor through capacity building and the development of regional and international networking platforms."

OKACOM

OKACOM was established in 1994 by Angola, Namibia, and Botswana to promote a coordinated approach to the sustainable management of the Okavango river basin. The Okavango River Basin Steering Committee (OBSC), appointed by the commission in 1995, is the technical advisory body to the commission. From a fisheries perspective, the most important OKACOM program is the Environmental Protection and Sustainable Management of the Okavango River Project. This is a GEF/UNDP/FAO-funded initiative that has developed a Transboundary Diagnostic Analysis (TDA) and formulated Strategic Action Plans for the River System. From a fisheries management perspective, OKACOM provides a compelling vehicle with which to effectively address transboundary issues.

Basin-Wide Forum

OkBMC Biodiversity Working Group

This is an initiative to protect biodiversity in the Okavango through partnerships between tourism lodges, schools, government departments, and other interested parties. OkBMC also helps in communication with communities adjacent to the river in Angola.

SAREP

The Southern Africa Regional Environmental Program (SAREP) is a five-year project to advance regional integration through activities that increase capacity for managing shared natural resources, improve social welfare, and strengthen the health sector's capacity to respond to HIV/AIDS, primarily in the Cubango-Okavango River Basin (CORB) by providing support to the Permanent Okavango River Basin Water Commission (OKACOM). SAREP will support the initiatives of OKACOM to integrate improved water and sanitation services with strategies that address threats to ecosystem services and biodiversity within the CORB and to strengthen regional capacity to adapt and respond to effects of climate change. SAREP is responsible for the production of this Transboundary Fisheries Management Plan. SAREP is operating in each of the three basin countries in collaboration with its country-based NGO partners, i.e., Angola (Association for Environmental Conservation and Integrated Rural Development), Botswana (KCS), and Namibia (NNF and IRDNC).

WWF in Namibia

WWF has worked in close cooperation with NNF to support the fisheries co-management project activities in Caprivi.

National Fisheries Departments

The governmental organizations responsible for fisheries management in the three countries are now collaborating closely and strongly support the development of the Okavango

Transboundary Fisheries Management Plan. Harmonization of regulations in all three countries is an important component of this management plan (Appendices 2 and 3).

Angola

Inland fisheries in Angola fall under the Directorate of Fisheries and Agriculture in each province, each of which has a Department of Fisheries.

The Angolan Ministry of Environment's Institute of Biodiversity (MINAMB) plays an active role in the fisheries. It has also worked with SAREP, having participated in the biodiversity survey in 2012. MINAMB is expected to be an active partner in the planning and implementation of the management plan.

Botswana

The government body in Botswana with responsibility for fisheries is the Fisheries Section of the Department of National Parks and Wildlife.

Namibia

The Ministry of Fisheries and Marine Resources is responsible for fisheries in Namibia. The Ministry has separate directorates, with the Directorate of Operations and the Directorate of Aquaculture and Inland Fisheries being mainly responsible for inland fisheries development and management.

Research Institutes

KIFI

The Kamutjonga Inland Fisheries Institute based just north of the Botswana border in Namibia is a MFMR facility that has the potential to be a major research institute for fish and fisheries research on the Kavango River in Namibia. It is envisaged that collaboration with ORI on fish and fisheries research and monitoring can greatly enhance the supporting role of both institutes.

INIP

The Ministry of Agriculture's National Institute of Fish Research (INIP) is a scientific institution of research and technological development contributing to marine and inland water research, including implementation, coordination and monitoring of applied research and experimental development marine fisheries, inland waters, lagoons, and estuaries. It studies aquatic biological resources, their environment, proposing measures for the conservation and rational management of living aquatic resources and ecosystems to play an active role in the use and conservation of fisheries resources. INIP also participated with MINAMB in the biodiversity survey in 2012, and is expected to be an active partner in the planning and implementation of the management plan.

IPA

IPA is the Institute for Development of Artisanal Fisheries and Aquaculture, involved in management and development of artisanal fisheries and aquaculture.

ORI

The Okavango Research Institute, based in Maun, is an institute of the University of Botswana. It is a center for the study and conservation of the Okavango Delta, established because this is one of the world's largest and most intact inland wetland ecosystems. ORI has played a major role in developing close relationships and partnerships between stakeholders in the Okavango Delta, particularly through the 5-year Okavango Wetland Biodiversity Conservation Project, known as the Biokavango project from 2006-2010. One of the outputs from that project was "Biodiversity friendly management methods are inducted into fisheries production systems. Output 1: Biodiversity friendly management practices demonstrated for fisheries sector. Output 2: Biodiversity safeguards are incorporated into national aquaculture programmes." With its existing high profile in the area, and as a partner in the NNF/EU Community Conservation Fisheries in KAZA Project, ORI is a major stakeholder in the implementation of the management plan.

Community Fisheries Organizations

Botswana. In Botswana, there are two community organizations representing fishers' interests. The Okavango Fisheries Management Committee (OFMC) is a forum for government agencies to interact with fishers, whereas the Okavango Fishers Association (OFA) is an association for fishers from the commercial, subsistence and recreational fishing sectors. These organizations, together with relevant traditional authorities, listed in the box below need to participate fully in the development and implementation of the management plan.

Botswana

- Okavango Fishers Association
- Okavango Fisheries Management Committee
- Association of Environmental Clubs of Botswana; government-run
- Community-based organizations
- Village Development Committees
- The Tribal Authority, government structure, not communities per se
- Leadership from traditional authorities in villages
- 5 community-based concessions in the Okavango

Also have CBOs, e.g., Okavango Kopano Mokoro Community Trust (OKMCT), Poler's Trust, Khwai. Each has management of trust and is primary stakeholder of fishery management in these areas. Outside of CBOs, SAREP has focused on village development committees, each of which is a company with one share per village member. Currently, trusts are proposed in other areas, e.g., Lake Ngami.

Namibia. Conservancies play an increasingly important role in natural resource management in Namibia. In Caprivi region, on the Zambezi River, Impalila and Sikunga Conservancies have established Fish Protection Areas (FPAs), a management concept that has tremendous potential in the Okavango system. The potential role of the three conservancies along the Kavango River needs to be investigated in the implementation of the management plan. Although two of these have boundaries that do not reach the river, this can be reviewed. The traditional authorities and regional councils are also recognized as important stakeholders in Namibian fisheries.

Namibia

- Traditional Authorities: 5 in Kavango
- Conservancies, 1 on river but 2 others could be extended to include river
- Schools, encouraged to form environmental groups
- Fishery committees, but none yet in Kavango
- Kavango Regional Council
- Subsistence fishers, some migrant fishers from Caprivi moving in

Angola

- Fishers' association with 20 members in the Municipality of Chitembo, Bie Province.
- 27 provincial associations of fishers in catchment, with 768 registered fishers in total.
- All areas have traditional authorities, i.e., chiefs, known as Sobas, who are undisputed leaders and are key to state or NGO interventions in the villages.
- A poverty relief program run by the government gives fishing communities 4 m boats, engines, gillnets, and hooks.
- Savate and Calai have organized cooperation.

Management Interventions

Objectives

The main objective of management intervention is to "contribute toward improving and maintaining the fish resources of the entire Okavango River Basin at a sustainable level thereby improving food security in the region" and, in a broader context, to secure sustainable utilization of the fish resources for the benefit of all stakeholders. This needs a much greater recognition of the role of tourism in the national economies. Several socio-economic studies have been made in Botswana, but there is still no clear way forward for maximizing the benefits of tourism to the local communities.

The major objective of the management plan should be to map the way forward to secure buy-in from all sectors for cooperation in management of the resources.

Policy Harmonization and Law Enforcement

The process for achieving this is already underway through inter-governmental dialogue, supported by SAREP. A comparative table of regulations in the three countries has been compiled and is included as Appendix 3. Harmonization issues to be resolved through the management plan include:

- *Prohibited gears.* Light attraction, poisons, explosives, and dragnets are prohibited by all; block nets are prohibited in Botswana (across lagoon entrances) and Namibia (more than halfway across watercourse); drifting nets are prohibited in Namibia and Angola.
- *Alien species.* Namibia and Angola need Minister permission, Botswana only Director. Latter needs modification to harmonize with others and provide better security at a higher level of government.
- *Closed seasons.* This is a contentious issue. A separate table is provided in Appendix 4 noting the biological and political pros and cons of having a closed season.

- *Transboundary agreement on gillnets.* Harmonization is needed for Namibia and Angola for the length of their shared boundary. Harmonization between Botswana and Namibia is less important.
- *Fishing license regulations.* Transboundary agreement is needed for Namibia and Angola for the length of their shared boundary.
- *Fishing councils*. Botswana has two fishers' organizations that can potentially be incorporated into a fisheries council for the Delta and Panhandle. The Okavango Fisheries Management Committee (OFMC) is a forum for government agencies to interact with fishers and therefore plays a similar role to that of a formal fisheries council. The Okavango Fishers Association (OFA) is an association for fishers from the commercial, subsistence, and recreational fishing sectors.
- *Protected areas.* Namibian and Angolan acts are in agreement. Botswana act needs to be modified to include similar provision for reserves/protected areas.
- *Mesh size regulations*. Agreement is needed for shared waters, but recognition is needed that different components of rivers, floodplains, and the Delta may need different regulations.

Law enforcement will also need to be coordinated between the three countries through agreements established through this management plan.

Current Status of Fish Populations, Fisheries Activities, and Implementation of Regulations, Acts, and Policies

The current knowledge of the status of fish populations is covered elsewhere in this document. In summary, Okavango Delta stocks are lightly exploited, with abundance most closely linked with variations in scale of the annual flood. Stocks in the Panhandle are exploited by tourist recreational anglers and commercial fishers, resulting in disagreements about the optimal use of the resources. The stocks remain healthy but with potential for localized depletion. In Namibia, Mahango National Park provides full protection for fish stocks, resulting in near pristine populations that a decade ago were reportedly five times greater than in more heavily exploited areas further upstream in Namibia, where exploitation rates have undoubtedly increased since. Exploitation rates in Angola are uncertain but increasing. The transboundary research and monitoring programs proposed in this management plan will greatly improve knowledge of the stocks by comparing results in areas of varying exploitation rates throughout the system.

A report contributing toward the development of a management plan for the Okavango in Botswana was prepared by Shipton (2011). Key issues put forward were: fisher organizations — the role of OFA/OFMC; institutional capacity for the DWNP Fisheries Division; transboundary cooperation; improved fisheries data; regulation review; compliance with fisheries and wildlife legislation; biological reference points; and CBNRM initiatives including promoting community-based tourism opportunities. These issues became the focus for discussion in the scoping process for this management plan, resulting in the development of this transboundary management plan, as many of the key issues are common to all three countries.

Policies to be promoted include facilitating governance arrangements in communities wishing to set aside areas for recreational fishing. This concept needs to be extended to include Fish

Protection Areas (FPAs) and earning of revenue from anglers for the communities. It needs very clear recognition of which communities actually own the fishing rights, and how potential revenue should be handled. Consideration may be given to registration of fishers currently operating in potential FPAs and potential employment by communities as fish guards to protect any FPAs that may be established. We consider the much-discussed option of zonation in the Panhandle of commercial and tourism angling areas to be too simplistic and likely to result in disagreement, conflict, and flouting of rules. In contrast, we argue for the establishment of FPAs by communities to establish areas where fish are protected and where communities can earn revenue from anglers through payment of rod fees to communities to fish (practicing catch and release) in the FPAs. The main long-term benefit to the communities is improved recruitment of fish to those adjacent areas that are open to fishing, but communities as a whole also benefit financially from the tourist rod fees.

Influence of Adjacent Basins. Collaborations, Alignments and Standardization of Monitoring Activities and Regulations

This project is just one component of increasingly integrated fisheries research and management activities throughout the region. KAZA is increasingly becoming a major partner in managing fisheries along with other transboundary natural resources.

The authors of this report are starting a new 4-year EU-funded project, following the completion of a 6-year, 2-phase project in Caprivi, Namibia, funded by NORAD and administered by NNF/WWF/MFMR. The new EU project expands on lessons learned in community-based management of the Caprivi Floodplain fisheries, and is extending the project's operational area to include the Okavango system. ORI is a partner in this new project, and all organizations operational in fisheries in the region are either full partners or associate institutions. The new project is coordinating activities in the Okavango region very closely with SAREP.

Standardization of monitoring activities and harmonization of legislation are discussed at length elsewhere in this management plan.

Driving Forces Within the Basin Affecting Fish Populations, Direct Threats, Conflicts and Indirect Impacts

Direct threats to the Okavango fisheries include increasing, unsustainable commercialization and widespread use of illegal, destructive fishing methods, in Namibia in particular, where influx of fishers from Caprivi with illegal gears is reported.

In Botswana, relations between the commercial, subsistence, and tourism fisheries sectors have reportedly improved but some distrust remains, evident in the minutes of stakeholder meetings published in Shipton (2011). The reported discussions show that many stakeholders share progressive viewpoints but others still do not understand the issues or the dynamics of fisheries. A different approach may yield dividends in securing much better cooperation between the sectors for the benefit of all stakeholders, a comprehensive list of whom is presented earlier in this document.

Irrigation schemes upriver that may flout agreed upon international protocols may impact downstream fisheries and other water-dependent sectors of the economy. These are issues

that need to be addressed but are perhaps beyond the scope of this management planning process.

Co-Management, Lessons From Elsewhere

Co-management is increasingly promoted in inland fisheries in Africa and elsewhere, with mixed results. In this southern African region, there are examples of both successes and failures, and here we present cases from Malawi. The most notable failure was, and still remains, the Lake Malombe fishery. In the 1980s, a change in fishing methods to target small cichlid species resulted in the demise of the important chambo (tilapia) fishery as a result of small-meshed nets (known as nkacha) destroying weed beds and catching excessive numbers of juvenile chambo (Tweddle et al., 1995). The fishery for the small cichlids also went into decline, resulting in a fishery worth 10 percent of the earlier fishery.

In response, a co-management system was proposed (Bell and Donda, 1993) and implemented (Hara, 2000, 2006a, 2006b, 2008). Beach village committees (BVCs) were established, composed of gear owners, crew members, processors, fish traders, active members of the village group, traditional leaders, and other co-management partners, e.g., NGOs such as CURE, Total Land Care, COMPASS, and WESM (Njaya et al., 2012). Their duties included regulating admission of additional gear owners, patrolling their fishing areas, organizing group members to discuss problems of the fishery, representing interests of their members at higher levels, such as associations, collecting data, and lobbying for policy reviews. In Malombe and the adjoining Upper Shire River, 31 such BVCs were established. The co-management arrangements have not, however, succeeded, and the fishery has remained severely degraded. Hara (2008) attributes the co-management failure to problems of representation on BVCs. His criticisms are shown in the box below.

Dilemmas of Democratic Decentralisation in Mangochi District, Malawi: Interest and Mistrust in Fisheries Management; Mafaniso Hara (Abstract)

To establish 'participatory' fisheries management, in 1993 Malawi's Fisheries Department constituted elected Beach Village Committees (BVCs) with village headmen as ex-officio members. But, struggles between elected BVC members and traditional authorities (TAs) over benefits from fisheries undermined the authority of elected members. Legal ambiguity on who should make decisions facilitated the takeover by headmen. Further, the BVC was elected by the population as a whole, representing more than just the fishers, whom these committees were designed to control. This resulted in the sabotaging of the BVCs activities by the fishers. Under these conditions, representing the whole population undermined the effectiveness of the BVCs. In 1998, decentralisation reforms placed 'community inclusion' in fisheries management under Village Development Committees (VDCs), whose members would be appointed by elected District Assemblies (DAs). This reform is likely to unleash a struggle over BVC-VDC relations. But, different visions of decentralisation, shared mistrust of local democracy, higher level battles for authority among the government, politicians and TAs stalled the decentralisation process. Donors supporting these reforms were also mistrustful of representative local institutions. The institutions chosen and recognised by the government under donor pressure are the sites of political struggles in which representation, a sense of belonging and downward accountability are losing ground.

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The major lesson to be learned, however, is that co-management of a natural resource can only succeed if there remains a resource to be managed, particularly in impoverished rural communities. The Lake Malombe chambo fishery can easily be restored, but not through co-

management in its present form, which has sadly resulted in 20 years of lost opportunity for what was once a valuable fishery.

In contrast, Lake Chiuta has proved a co-management success story (Njaya et al., no date), although one might question the form of the co-management. The co-management initiative began when the lake was invaded by fishers from Lake Malombe and from neighboring Lake Chilwa, using the same destructive nkacha nets that destroyed the Lake Malombe fishery. The Chiuta fishers succeeded in establishing their own management system and removing the nkacha fishers, but only after reported fierce conflict. Lake Chiuta is a healthy lake with extensive weed beds and yields a stable fish harvest for the local communities. Co-management on Lake Chiuta was successful for two reasons; a resource that had not yet been seriously overfished but could clearly be observed to be under attack; and, reportedly (discussions between D. Tweddle and fishers at Dinje Village, Lake Chiuta, in March 2013) a very strong local chief driving the program. One might, however, question whether this is genuine co-management or another form of top-down management, but through a strong chief and not central government. Donda (PDF on-line, no date or attribution), however, noted that village heads were excluded from BVCs on Chiuta but dominated those of Lake Malombe. Also Malombe BVCs were dominated by non-fishers (70 percent) but Chiuta BVCS were mainly fishers (80 percent). Njaya et al. (no date) stated that " Indications are that so long as the threat of nkacha fishers gaining access into the fishery exists, mobilization of the fishers will remain strong. The fact the fishers initiated the organization for management on their own remains the best foundation for sustainability of the arrangement."

There is general recognition that co-management systems are necessary in rural subsistence and artisanal fisheries, and these goals are being pursued in the countries bordering the Okavango and Upper Zambezi River systems. In Zambia and Namibia these goals are clearly recognized in their inland fisheries legislation. For the Caprivi floodplain, in both Namibia and Zambia, fishing communities are actively encouraged and assisted to set up fisheries committees with the assistance of government, traditional authorities, and NGOs (NNF and AWF).These committees are having varying success. Both successes and failures help to inform this management plan. Successes include Sikunga and Impalila Conservancies. A current failure in co-management was experienced in the Lisikili area adjacent to Sikunga Conservancy, where it proved difficult to establish a fully representative fishery committee because of disagreements and distrust in neighboring communities. The Muyako village fisheries committee on Lake Liambezi was highlighted as a success story (Tweddle et al., 2011), then became a problem area with the fisheries committee not implementing agreements they had established, but now (in June 2013) the committee has re-established control through a system of registering canoes, prohibiting foreign fishers from fishing the lake, and closing the lake for two weeks to enable ghost nets to be removed.

Guidelines for co-management in Okavango/Cubango fisheries, based on the lessons learned elsewhere, are presented in Part B of this management plan.

Fish Protection Areas

The Caprivi Model

Two pilot Fish Protection Areas (FPAs) have been established in Caprivi. These are (1) the Kasaya Channel, that links the Zambezi River with the Chobe River, thereby creating Impalila Island, which forms the conservancy managing the FPA, and (2) the Sikunga Channel in Sikunga Conservancy. The establishment of these reserves followed a long

consultation process in the fishing communities, which were concerned about the deterioration in their fish stocks as a result of an enormous increase in fishing effort with destructive gears. With the assistance of the MFMR/NNF/WWF Zambezi/Chobe Fisheries Project, potential FPAs were identified and mapped, and two pilot sites with the greatest chance of success were established. Criteria for potential success were size, biological suitability, ability to control, ensuring that local fishers would not be disenfranchised, and potential for earning revenue from tourism primarily through fee-paying catch-and-release angling. A full background of the processes involved in setting up the FPAs was submitted to the Ministry (Tweddle and Hay, 2011b). Following their successful establishment, funds were obtained from the Millennium Challenge Account to equip the two conservancies for the first year of operation with boats, engines, publicity materials, start-up salaries for monitors, etc. The FPAs will subsequently become self-financing through tourism income.

In neighboring Zambia, the African Wildlife Foundation in partnership with the Department of Fisheries is also working with fishing communities and with the Barotse Royal Establishment, establishing fishers' committees, and identifying and setting up FPAs in each of the committees' areas.

MONITORING ACTIVITIES AND SURVEYS

Longitudinal Profile of Fish Populations Fully Documented, From the Riverine Habitats in Angola to the Seasonal Swamps in the Lower Delta in Botswana

Bills and Skelton (2013) have just produced the first report on the fishes of the upper tributaries of the Cubango/Okavango system, after a survey that yielded several new species and new records for the system. A new survey is underway. Further downstream, the fauna is fairly well known (Skelton, 2001; Tweddle et al., 2003) both locally and in a regional context (Tweddle et al. 2009), but nevertheless new species are still being found (Kramer et al., 2012; Tweddle, unpublished data) and other species brought out of synonymy (Kramer and Van der Bank, 2011).

In terms of fish assemblages and population abundances, the surveys proposed here will fully address any questions that might arise.

Introduction to Fisheries Monitoring Surveys

To understand the dynamics of a floodplain river system, high-quality, long-term data series with predetermined spatial and temporal intervals are needed. These surveys do put strain on the already stressed out resources from government, which usually leads to diluted research and monitoring approaches where data are recorded in such a way that the most important questions asked by managers remain unanswered. Taking into account the importance of the fish resource from the Okavango River, especially for women, children and the rural poor communities, a collaborative, well planned approach should be put in place to ensure that this valuable resource is utilized sustainably for the benefit of these stakeholders.

Several shortcomings are noted when assessing the availability of data on the fish and the fisheries from the Okavango River. The intensity of data collection differs between the three countries due to different policy approaches, availability of financial and manpower resources, infrastructure development, and experience levels of fisheries scientists. The first step would be to assess and to document the current status of available data, the data format

and the spatial and temporal distribution of areas sampled in Angola, Botswana, and Namibia. From these, research gaps could be identified and a research strategy jointly developed between fisheries scientists from the three countries.

The immediate objective once the research gaps have been identified would be to establish a long-term monitoring system synchronized between Angola, Botswana, and Namibia for the development of a database recorded longitudinally along the entire Okavango River Basin with efficient flow of information between scientists and managers for assessing fish stocks and ecosystem functioning.

Rationale for Monitoring Activities and Data Collection

- Compile fish species lists.
- Determine the status of the different fish species, especially commercially important species.
- Recommend measures to protect the species diversity.
- Use indices to assess environmental degradation, seasonal changes, and exploitation of the fish population.
- Obtain ecological and biological data to study the life history of commercially important species.
- Determine the catch efficiency and species composition of different fishing gears.
- Document seasonal yields/catch rates from the subsistence and commercial fisheries for the system.
- Document catches from the tourism industry (recreational fishery).
- Obtain socio-economic data on the role played by fish in food security.
- Ensure research results are translated into management plans/actions.

Fishery Independent Data

Harmonization and Agreed Scientific Methodology Between Countries Sharing a Resource

Standardized survey methodology should be adopted in the three countries leading to the development of shared databases accessible to all three countries. The SADC Protocol on Fisheries states in Article 18 point no. 3 on Information Exchange that, "State Parties shall regularly consult on methodologies and approaches that will harmonize and enhance the reliability of data collection." The harmonization of scientific methodologies between countries sharing a common fish resource has already been agreed upon by all SADC states, and the mandate for this falls within the different departments in the different countries responsible for inland fisheries.

The knowledge base of the fish fauna in the catchment of the Cubango-Okavango River Basin in Angola is poor. An initial survey done in 2012 further emphasized the lack of any baseline data on the fish fauna from the catchment area (Brooks, 2012). Two key findings were made during the study: the total lack of certain groups from the Okavango Delta found in the catchment areas, and the different fish assemblages between the Cubango River and the Cuito River and their tributaries. Close affinities were found between the Cubango catchment and the Okavango Delta, Kunene and Cuanza River fish fauna showing the level of speciation between these river basins. Each tributary has its own characteristic fish fauna, with possibly still some un-described species. The Department of Fisheries in Angola used to do surveys every May with 30 people assessing different fishery communities, but there are

currently no surveys being conducted in the Cubango River in Angola. Angolan fisheries monitoring is still in its infancy, but there are data for the Quanza River, where two surveys are completed each year by fishers looking at the length, size, and species of fish.

The Ministry of Fisheries and Marine Resources, Namibia started a monitoring program in the Kavango River (the section bordering Angola) in 1992 and identified five stations that are annually monitored. These surveys are done during the high and low flood periods. A series of gill nets with 11 different mesh sizes (12-150mm mesh size, each mesh panel being 10m in length) are used to sample fish at each sampling station. A representative catch is collected at each station by using a variety of fishing gear as well as sampling all different habitat types at each station. The parameters recorded are gear type used, species, length, weight, sex, and gonad stage. Very basic information regarding the habitats is also noted. Data are then entered into PASGEAR, a customized database. Some documentation is available giving baseline information for surveys done between 1994 and 2010.

The data collected by the ministry between 1994 and 2010 were divided into protected and non-protected areas. No definite change could be observed in the catches from the experimental gill nets either in the protected or non-protected areas between 1994 and 2010, although there seems to be a significant difference in catches between protected and non-protected areas. The population structure also differs between these two areas, with larger fish (k-selected) sampled from the protected area (Munwela, 2011). Larger individuals are usually first targeted by the local fishing communities as these give the best return on investment, whether for selling or own consumption. This would be the first indication of fishing having an impact on the resource. More detailed statistical analysis is recommended with the available data to unconditionally state that no change in catches took place between 1994 and 2010.

The Department of Wildlife and National Parks (DWNP), Botswana conducts monthly surveys at four stations in the Panhandle (since 1999) and recently a further four stations in the Lower Delta including Lake Ngami, recently inundated after good rains fell in the catchment areas. A multifilament gill net set similar to that used by Namibia is deployed by the DWNP at these different stations. The parameters recorded are gear type used, species, length, weight, and gonad stage. Data recorded are entered into PASGEAR. Quarterly reports are produced, but it seems that very little of the information is incorporated into the management of the resource. The Okavango Research Institute (ORI) plays a supportive role in research whereby data recorded are forwarded to ORI for further analysis. The current sampling frequency put pressure on the department's resources and has manpower, logistical, and financial implications and should be reviewed (Shipton, 2011).

Data collected by DWNP point to a decline in the catch per unit effort (CPUE) of the experimental gill nets since 2006. The reason for this decline is unknown and could be related to the recent higher floods experienced in the Delta. Higher water levels usually result in lower catches. However, it is crucial that these data be statistically analyzed and integrated into future management actions.

Data Sharing Protocol

The SADC Protocol on Fisheries states in Article 17 point no. 3 on Science and Technology that "State Parties agree that knowledge and data generated through joint regional fisheries research projects and programs shall be shared by the participating State Parties." A protocol

on data sharing should be developed outlining the technical aspects, the responsible institution/s for maintaining the database, the process in accessing data and quality control. It is proposed that a steering committee takes responsibility for the development of such a database. The database created should be for storage and analysis of resource information necessary for effective joint management purposes. The only means to effectively harmonize the research done on the Okavango River would be to develop a shared database with data recorded at a standardized and systematic approach. This database will form the foundation from which all recommendations for management purposes will be developed, reports and peer review papers published, and capacity build throughout the region.

Currently several databases are available from the three countries with a range of variables recorded that are differently dispersed both spatially and temporally. These databases are not standardized, however, and the objectives for collecting these datasets differ between the countries, making these datasets inadequate to establish a shared database for studies relating to the entire river basin.

The goals for developing a common database are:

- Facilitating access for stakeholders to fish data from the entire river basin.
- Storing fish data from the entire river basin over an extended period for the identification of trends to serve as a management tool.
- Facilitating development of a basin-wide management approach.
- Evaluating and enhancing the quality and standardization of data recorded.
- Training scientists from the three countries in data management and storage.
- Guaranteeing safekeeping of a database (digital and hard copies).
- Enhancing communication between scientists.

Long-Term Monitoring Programs

Long-term monitoring programs are necessary with good-quality data analyzed appropriately and translated into management policies. This is a long and tedious process, and the monitoring programs and research activities must be done in a statistically correct manner to ensure that data collected are relevant for management purposes. The main objective of a governmental institution should be the development of a long-term monitoring program for the identification and evaluation of trends within fish populations. This will form the basis of any fisheries management plan. A system for long-term ecological monitoring of fish stocks should be developed jointly by Angola, Botswana, and Namibia to ensure that all areas of mutual interest are incorporated.

Joint Research Programs

Apart from joint monitoring programs, countries should further co-operate in establishing joint research programs and projects with particular reference to shared resources and scientific problems of mutual interest. This will also include research programs conducted by tertiary institutions or other organizations related to fisheries. Knowledge and data generated through joint regional fisheries research projects and programs should be shared between the different countries. This will prevent duplication in research undertakings and, as a further benefit, enable costly facilities and equipment to be shared. This will also create the opportunity to attach postgraduate students to these regional fisheries research projects,

enhancing capacity building within each government department, currently a major obstacle preventing the region from producing high-quality science.

Countries should work toward generating and applying best scientific advice as a basis for decision-making on the sustainable use of the resource. This will be enhanced through:

- Peer review including external evaluation of research by recognized centers of excellence
- Regional and international participation in national research seminars
- Collaboration with scientists from abroad on regional research projects
- Promotion of publications of regional interest, including electronic journals, and networks and professional associations

Joint Steering Committee (Technical or Advisory Committee)

It is envisaged that a joint steering committee will be established to facilitate and strengthen collaboration and communication on a technical level. This committee will have a role to play in the approval of research and monitoring programs to be conducted and will be responsible for the timely execution of these programs. Furthermore, the committee needs to ensure that the collaboration, joint research, and monitoring programs between the three countries continue after this project and that the process is sustainable considering future resources and infrastructure. The mandate of this committee should be clearly spelled out and the committee must be officially endorsed by the countries.

Training

Government fisheries staff should be trained in the use of equipment and research methodologies. Staff should be encouraged to further their studies by enrolling at tertiary institutions specializing in fisheries. The research projects envisaged for this river system will allow staff the opportunity to register for postgraduate studies at these tertiary institutions.

It is further recommended that government scientists work closely with international scientists as a process of in-service training. This will ensure that joint project reports and papers in peer-reviewed journals are published, further strengthening capacity building.

Formal and informal workshops should be held where data recorded are jointly analyzed by scientists from the three countries, outlining recommendations for management purposes.

Biological Reference Points

The objective of a management plan is to maximize the socio-economic benefits for the local communities. This can only be done if a resource is managed in a biologically sustainable manner. The setting of biological reference points is a recognized method to measure whether the goals of the management objectives have been met. Floodplain systems are, however, very dynamic and the enormous natural fluctuations make the setting of biological reference points based on species population dynamics extremely difficult, if not totally irrelevant. Large parts of the Okavango River have been impacted by people through development projects although there are still pristine habitats along the system, particularly in the tourism

areas of the Delta. Baseline data could therefore be used from near pristine environments against which to measure impacts of fishing and other activities in more heavily utilized areas. Biological reference points then need to be identified for each river section, if possible for different habitat types.

Station Selection

The rationale for selecting stations for monitoring purposes is to standardize data collection to facilitate the identification of trends within the fish population. Several aspects must be considered when selecting stations for future long-term monitoring programs. Potential stations should include a variety of habitat types including areas of intense fishing activities. At least one area that could be considered low impact or even protected area, such as a game park or conservancy, should be selected. The station should be accessible throughout the year for monitoring purposes.

Fishery Dependent Data

Standardization of data collection is also important for the fishery independent data.

Catch Assessment Surveys

A floodplain fishery is very dynamic, and fishers tend to adapt their fishing effort according to fluctuations of the fish stocks. These catches consist of three different segments. There are the catches mostly done by women using traps, baskets, or fine mesh nets. They target the smaller species (r-selected species) and use them for their own consumption, with a small percentage sold locally. The more commercialized approach is the use of gillnets targeting larger fish, predominantly bream, for the local or even the export market. The commercialized approach differs between the three countries, depending on the level of support fishers receive from government institutions, the availability of fish, and whether the fishery is market driven. The third segment is the tourism sector, where tigerfish and bream species are targeted. Catch and release is practiced, with very little impact on the resource. Documenting these changes in fishing effort and the catches from the fisheries is vital when studying floodplain fisheries. Governments do not usually have the manpower or financial resources to conduct these studies. The local communities should be trained to monitor catches from the subsistence and commercial fishery, and lodges should be involved in documenting their clients' catches. This is a very cost-effective way of developing large databases over the long term and the only way of estimating the annual harvest taken from the system. This initiative, where communities are involved in research activities, further strengthens their sense of ownership, promoting more support from communities and other stakeholders toward a co-management approach.

In Botswana, it was logistically difficult to collect catch returns from the commercial fishery in the Delta, and the quality of the data collected has also been questioned. The individual weights recorded were deemed unreliable and were discarded. Data reported do indicate that the catch rates from the fisher catches in the Delta seem to have been stable between 1996 and 2002 and do not show any decline in the catch rates of the gillnet fishery in the Delta.

No reliable data on the subsistence/commercial fishery is available from the Namibian section of the river. Logistically it is very difficult to record data from the local fishery from this section of the river as no landing sites are present and there are no formal fish markets in

this river section. Each fisher will catch fish from the river near his or her village and return to the village or sell some of the catch along the road.

No surveys are being conducted in Angola in the Cubango River, but two surveys per annum are done by local fishers in the Quanza River, recording length, size, and species sampled.

Frame Surveys

Frame surveys will provide information on the demographics of the fishing community. Valuable data obtained are on the number and size of fishing gear used, number of boats/vessels, number of fishing days per fisher, landing sites, and spatial and temporal fishing activities. These will supplement the data recorded through the catch assessment surveys and will give an overview of the fishing effort. Very few frame surveys have been conducted throughout the system, with one survey done in Namibia and two surveys in Botswana (the latest in 2005). Very little is known about the fishing effort from the catchment area. Data available are insufficient and are not standardized between the different countries and may be difficult to evaluate.

Frame surveys should be conducted systematically every three to five years and coordinated between the three countries. These data will be needed to estimate the annual harvest, fishing effort, and fishing patterns of the subsistence and commercial fisheries.

Local Fish Markets

Local fish markets are a major driving force of fishing intensity, fishing effort, and species selectivity in the region. Usually high valued cichlid species dominate local fish markets, and these species are usually specifically targeted by the fishers to ensure a profitable return on their investment. These are generally large individuals (k-selected species) with a longer generation period. These species are also more vulnerable to overfishing and are the first species to indicate any pressure on the resource. These species have a potential for the export market to neighboring countries. Lesser valued species such as the smaller minnows and squeakers do play an important role and may be sold locally, mainly by women, or used for own consumption.

Local fish markets should be monitored to assess fish prices and species preferences. Fish markets also relate to the state of the resource in the river system and can be used as an index to verify data recorded from the catch assessment surveys.

Recreational Fishery

The tourism recreational fishery contributes immensely toward the economy of the region, conservation of the resource, and job creation. This industry is important in generating revenue specifically benefiting the local communities, where certain areas as agreed per community could be closed for any fishing except for those practicing catch and release. In this way communities can still receive an income in the way of levies, making it possible to close certain areas for fishing. Funds could then be generated to employ local community members to enforce the closure of these areas. Data recording should therefore form part of the monitoring activities by involving the recreational anglers and lodges in the process.

Outbreak of Disease and Presence of Alien/Exotic Fish Species in the System

The Okavango River is a complex and dynamic river system providing a range of ecological services to the local communities as well as to national governments. The wide range of activities (development projects) spread along the river basin always poses a threat for the intentional or unintentional introduction of diseases, pathogens, or alien species into the system. These introductions could impact on the fish resource, as was seen with the discovery of Epizootic Ulcerative Syndrome (EUS) from the Zambezi and Chobe River Systems. Recently, EUS has also been recorded from the Okavango River basin. An early warning system should be put in place to monitor the spread of these introductions.

Joint Patrols (Namibia and Angola)

Conducting conventional patrols to effectively implement any legislation on a river that forms an international border is extremely difficult. The section of the Okavango River forming the border between Namibia and Angola is approximately 460 km in length, further complicating organization of patrols to be undertaken along this stretch of river. Joint patrols by Namibian and Angolan authorities should be conducted, first to educate and inform the riverine communities and second to ensure harmonized interpretation of legislation for the two authorities. These patrols should include the Police, immigration, and fisheries departments.

LITERATURE CONSULTED

Andrew, T.G., Huchzermeyer, K.D.A., Mbeha, B.C. and Nengu, S.M. (2008). Epizootic ulcerative syndrome affecting fish in the Zambezi River system in southern Africa. Veterinary Record 163, 629–632. http://dx.doi.org/10.1136/vr.163.21.629,PMid:19029110.

Basson, L. and Van As, J.G. (2002). Trichodinid ectoparasties (Ciliophora: Peritirchia) of freshwater fishes of the family Anabantidae from the Okavango River and Delta (Botswana). Folia Parasitologica, 49: 169-181.

Bazigos, G.P. (1972). The improvement of the Malawian fisheries statistical system. Rome, FAO, FAO/MLW/16: 23 pp.

Bills, R. (1996). Fish Stock Assessment of the Okavango River. JLB Smith Institute of Ichthyology Investigational Report no 56: 110 pp.

Bills, R., Skelton, P. and Almeida, F. (2012). Survey of the fishes of Upper Okavango River System in Angola. Report to SAREP. SAIAB Investigational Report no 73: 61 pp.

Bell, R.H.V. and Donda, S.J. (1993). Community Fisheries Management Programme: Lake Malombe and Upper Shire River Consultancy Report. Vol. 1 and 2. Mangochi: Government of Malawi, Department of Fisheries and the Malawi -Germany Fisheries and Aquaculture Development Project (MAGFAD).

Biokavango Project (2011a). http://www.orc.ub.bw/biokavango/content/code-conduct-responsible-fishing-the-okavango-delta.

Biokavango Project (2011b). Fishing free zone at the upper Panhandle fisheries pilot site. http://www.orc.ub.bw/biokavango/content/fishing-free-zone-upper-panhandle-fisheries-pilot-site

Bokhutlo, T., Kootsositse, M.V., Mosepele, K. (2007). Okavango Delta fishery frame survey draft report. Okavango Delta Management Plan.

Booth, A.J. and McKinlay, B.W. (2001). Spatial aspects to the reproductive and feeding biology of the striped robber Brycinus lateralis (Pisces: Characidae) inhabiting the Okavango Delta, Botswana. African Zoology 36(1): 31-40.

Booth, A.J. and Merron, G.S. (1996). The age and growth of the greenhead tilapia Oreochromis macrochir (Pisces: Cichlidae) from the Okavango Delta, Botswana. Hydrobiologia 321: 29–34.

Booth, A.J., Merron, G.S., and Buxton, C.D. (1995). The growth of Oreochromis andersonii (Pisces: Cichlidae) from the Okavango Delta, Botswana, and a comparison of the scale and otolith methods of aging. Environmental Biology of Fishes 43: 171–178.

Brooks, C. (2012). Trip report: Aquatic biodiversity survey of the upper Angolan catchment of the Cubango-Okavango River basin. Chemonics International Inc. for USAID, 23 pp.

Canonico, G.C., Arthington, A., McCrary, J.K. and Thieme, M.L. (2005). The effects of introduced tilapias on native biodiversity. Aquatic Conserv: Mar. Freshw. Ecosyst., 16: 463-483.

Christison, K.W., Basson, L. and Van As, J.G. (1999). Branchial monogenean parasites (Monogenea: Dactylogyridae) of characin fishes from the Okavango River and Delta Botswana. 5th International Symposium of Fish Parasites. Symposium held in Ceske Budejovice, Czech Republic.

Christison, K.W., Basson, L. and Van As, J.G. (2001). Monogenean fish parasites from the Okavango Delta, Botswana. 4th International Symposium on Monogenea, Symposium held in Brisbane, Australia.

Christison, K.W., Shinn, A.P. and Van As, J.G. (2005). Gyrodactylus thlapi n.sp. (Monogenea) from Pseudocrenilabrus philander philander (Weber, 1897) (Cichlidae) from the Okavango Delta, Botswana. Systematic Parasitology, 60: 165-173.

Christison, K.W., Van As, J.G. and Basson, L. (1998). Annulotrema gill parasites of Okavango characins. Microscopy Society of Southern Africa, Symposium held in Johannesburg, South Africa.

Christison, K.W., Van As, J.G. and Basson, L. (1999). Monogenean gill parasites of Okavango Fishes. Microscopy Society of Southern Africa, Symposium held in Bloemfontein, South Africa.

Cooke, S.J., Danylchuk, A.J., Danylchuk, S.E., Suski, C.D., and Goldberg, T.L. (2006). Is catch-and-release recreational angling compatible with no-take marine protected areas? Ocean and Coastal Management, 49: 342–354.

Dibbs, J.L. (1965). Report on fishery development prospects in Bechuanaland. FAO, Rome.

FAO (1998). Guidelines for the routine collection of capture fishery data. FAO Fisheries Technical Paper 382: 113 pp.

Fox, P.J. (1976). Preliminary observations on fish communities of the Okavango Delta. In Proceedings of the symposium on the Okavango Delta and its utilization. National Museum, Gaborone, Botswana, August 30th to September 2nd, 1976. Botswana Society, 125-130.

Gilmore, C. (1979a). Food preferences and trophic relationships of fish from two unenriched Okavango Delta "Madiba." Botswana Notes and Records, 11: 103-106.

Gilmore, C. (1979b). the effects of ULV aerial applications of Endosulphan on the feeding habits of "Schilbe mystus" and "Mormyrus lacerda" in the Okavango Delta, 1977. Botswana Notes and Records, 11: 107-114.

Gilmore, K.S. (1976a). The river and floodplain fishery of the Okavango Delta, Botswana. In Symposium on river and floodplain fisheries in Africa, edited by R.L. Welcomme. CIFA Tech.Pap./Doc.Tech.CPCA, (5).

Gilmore, K.S. (1976b). Development potential and constraints of a fishing industry in the Okavango Delta. In Proceedings of the symposium on the Okavango Delta and its utilization. National Museum, Gaborone, Botswana, August 30th to September 2nd, 1976. Botswana Society, 175-178.

Gilmore, K.S. (1979). An investigation into the decline of the Yambezi Fisher's Co-operative Society. Botswana Notes and Records, 11: 87-102

Government of Botswana (1975). Fish Protection Act 42.

Government of Botswana (1990). Tourism policy. Gaborone: Government Printer.

Government of Botswana (2002). Botswana: National Development Plan 9. Part I – policies and objectives. 457p.

Government of Botswana (2008). Fish Protection Regulations.

Government of Botswana (2010a). Botswana: National Development Plan 10. Volume 1 – Strategies, Policies and Programmes. 357p. (Downloadable at http://www.gov.bw/en/Ministries--Authorities/Ministries/Ministry-of-Finance-and-Development-Planning).

Government of Botswana (2010b). Botswana: National Development Plan 10. Volume 2 – Projects. 109p. (Downloadable at http://www.gov.bw/en/Ministries--Authorities/Ministries/Ministry-of-Finance-and-Development-Planning).

Government of Namibia (2003a). Inland Fisheries Resources Act, 2003. Government Gazette of the Republic of Namibia, 2962.

Government of Namibia (2003b). Inland Fisheries Resources Regulations: Inland Fisheries Resources Act, 2003. Government Gazette of the Republic of Namibia, 2992.

Hall, D.N.F. (1971). Report on a visit to Botswana. ODA, London.

Hara, M. (2000). Fisheries co-management; what and whose Agenda? 1st WARFSA/WaterNet Symposium: Sustainable Use of Water Resources, Maputo, 1-2 November 2000: 1-7.

Hara, M. (2006b). Production relations and dynamics among user-groups in the artisanal fisheries of Malawi. Implications for representation in co-management arrangements. MAST, 4(2): 53-71.

Hara, M. (2006a). Restoring the chambo in Southern Malawi: Learning from the past or re-inventing the wheel? Aquatic Ecosystem Health and Management, 9(4):419–432.

Hara, M. (2008). Dilemmas of democratic decentralisation in Mangochi District, Malawi: interest and mistrust in fisheries management. Conservation and Society 6(1): 74–86, 2008.

Hay, C.J. (1995). The development of a data base for the assessment of the biotic integrity and sustainable utilization of the Okavango River, Namibia. Ph.D. thesis, Rand Afrikaans University.

Hay, C.J., Næsje, T.F., Breistein, J., Hårsaker, K., Kolding, J., Sandlund O.T. and v. Zyl, B. (2000). Fish populations, gill net selectivity, and artisanal fisheries in the Okavango River, Namibia. Recommendations for a sustainable fishery. NINA/NIKU Project Report no 10: 105 pp.

Hay, C.J., Van Zyl, B.J., and Steyn, G.J. (1996). A quantitative assessment of the biotic integrity of the Okavango River, Namibia, based on fish. Water SA, 22(3): 263- 284.

Hay, C.J., van Zyl, B.J. and Steyn, G.J. (1997). Ecology of Synodontis nigromaculatus from the Okavango River. Journal of African Zoology, 111(5): 355-363

Hocutt, C.H., Johnson, P.N., Hay, C.J. and Van Zyl, B.J. (1994). Biological basis of water quality assessment: Kavango River, Namibia. Rev. Hydrobiol. trop. 27 (4): 361-384.

Kgathi, D.L., Mmopela, G. and Mosepele, K. (2005). Natural resources assessment in the Okavango Delta, Botswana: Case studies of some key resources. Natural Resources Forum, 29, 70-81.

Kramer, B., Bills, R., Skelton, P. and Wink, M. (2012). A critical revision of the churchill snoutfish, genus Petrocephalus Marcusen, 1854 (Actinopterygii: Teleostei: Mormyridae), from southern and eastern Africa, with the recognition of Petrocephalus tanensis, and the description of five new species. Journal of Natural History, 46(35-36):2179-2258.

Kramer, B., Skelton, P.H., Van der Bank, F.H. and Wink, M. (2007). Allopatric differentiation in the Marcusenius macrolepidotus species complex in southern and eastern Africa: the resurrection of M. pongolensis and M. angolensis, and the description of two new species (Mormyridae, Teleostei). Journal of Natural History, 41: 647-708.

Kramer, B. and Van der Bank, F.H. (2011). The Victoria Falls, a species boundary for the Zambezi Parrotfish, Cyphomyrus discorhynchus (Peters, 1852), and the resurrection of Cyphomyrus cubangoensis (Pellegrin, 1936) (Mormyridae: Teleostei) Journal of Natural History, 45(43–44): 2669–2699.

Kramer, B., Van der Bank, F.H., Wink, M., Flint, N. and Sauer-Gürth, H. (2003). Evidence for parapatric speciation in the mormyrid fish, Pollimyrus castelnaui (Boulenger, 1911), from the Okavango - Upper Zambezi River Systems: P. marianne sp. nov., defined by electric organ discharges, morphology and genetics. Environmental Biology of Fishes, 77: 47-70.

Lopes, P.F.M., Silvano, R.A.M. and Begossi, A. (2011). Extractive and Sustainable Development Reserves in Brazil: resilient alternatives to fisheries? Journal of Environmental Planning and Management, 54(4): 421–443.

Marr, A. (1965). Report on fisheries survey in Bechuanaland B.P. 1963/64. OXFAM.

Mbaiwa, J.E. (2002). The socio-economic sustainability of tourism development in the Okavango Delta, Botswana. Conference on environmental monitoring of tropical and subtropical wetlands. Maun, Botswana, 4-6 December 2002, 495-519.

Merron, G.S. (1987a). Okavango Fisheries Research programme 1986 progress report. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No 22. 14 pp.

Merron, G.S. (1987b). Predator-prey interactions in the Okavango Delta: the annual catfish run, October-December, 1986. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No 25. 35 pp.

Merron G.S. 1991. The ecology and management of the fishes of the Okavango Delta, Botswana, with particular reference to the role of the seasonal floods. Rhodes University, Ph.D. thesis. 171 pp.

Merron, G.S. (1992). Tsetse fly control and the environmental implications for fish in the Okavango Delta, Botswana. Botswana Notes and Records, 24: 49–56.

Merron, G.S. (1993a). The diversity, distribution and abundance of the fishes in the Moremi Wildlife Reserve, Okavango Delta, Botswana. South African Wildlife Research, 23: 115–122.

Merron, G.S. (1993b). Pack-hunting in two species of catfish, Clarias gariepinus and C. ngamensis, in the Okavango Delta, Botswana. Journal of Fish Biology, 43: 575–584.

Merron, G.S. and Bruton, M.N. (1984a). Report on the October-November 1983 expedition to the Okavango Delta, Botswana. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No 8. 21 pp.

Merron, G.S. and Bruton, M.N. (1984b). Report on the June-July 1984 expedition to the Okavango Delta, Botswana. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No 12. 33 pp.

Merron, G.S. and Bruton, M.N. (1988). The Ecology and Management of the Fishes of the Okavango Delta, Botswana, with Special Reference to the Role of the Seasonal Floods. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 29. 291 pp.

Merron, G.S. and Bruton, M.N. (1990). The physiological and toxicological effects of aerial spraying with insecticides on the fish stocks of the Okavango Delta, Botswana. WWF Project 3914 Interim Report no 2. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 31: 49 pp.

Merron, G.S. and Bruton, M.N. (1995).Community ecology and conservation of the fishes of the Okavango Delta, Botswana. Environmental Biology of Fishes, 43: 109–119.

Merron, G.S., Bruton, M.N. and Skelton, P.H. (1984a). Report on the March-April 1984 expedition to the Okavango Delta, Botswana. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 10: 27 pp.

Merron, G.S., Bruton, M.N. and Skelton, P.H. (1984b). Brief synopsis of the main findings and objectives of the Okavango Fish Research Programme performed by the JLB Smith Institute of Ichthyology. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 11: 6 pp.

Merron, G.S., Bruton, M.N. and Skelton, P.H. (1985). Report on the October-December 1984 expedition to the Okavango Delta, Botswana. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 15: 35 pp.

Merron, G.S, Holden, K.A. and Bruton, M.N. (1990). The reproductive biology and early development of the African pike, Hepsetus odoe, in the Okavango Delta, Botswana. Environmental Biology of Fishes, 28: 215–235.

Merron, G. S. and Mann, B. Q. (1995). The reproductive and feeding biology of Schilbe intermedius Rüppell in the Okavango Delta, Botswana. Hydrobiologia, 308: 121-129.

Mmopelwa, G.M., Raletsatsi, S. and Mosepele. K. (2005). Cost Benefit Analysis of Commercial Fishing in Shakawe, Ngamiland. Botswana Notes and Records, 37,11-21.

Mmopelwa, G., Mosepele, K., Mosepele, B., Moleele, N. and Ngwenya, B. (2009). Environmental variability and the fishery dynamics of the Okavango Delta, Botswana: the case of subsistence fishing. Afr. J. Ecol., 47 (1), 119–127.

Moravec, F. and Van As, J.G. (2001). Philometroides africanus sp.n. (Nematoda: Philometridae), a new tissue parasite of the African pike Hepsetus odoe (Pisces) in Botswana. Folia Parasitologica, 48: 127-131.

Moravec, F. and Van As, J.G. (2004). Some nematodes from the squeaker fish Synodontis nigromaculatus and S. vanderwaali from the Okavango River and Delta, Botswana, including three new species. Systematic Parasitology, 59: 169-187.

Mosepele, K. (2000). Preliminary Length Based Stock Assessment of the Main Exploited Stocks of the Okavango Delta Fishery. Mphil Thesis, Department of Fisheries and Marine Biology, University of Bergen, Norway.139 pp.

Mosepele, K. (2001). Preliminary Description of the Okavango Delta Fishery. Fisheries Section, Ministry of Agriculture, Botswana. 132 pp.

Mosepele, K. and J. Kolding (2003). Fish Stock Assessment in the Okavango Delta, Botswana – Preliminary Results from a Length Based Analysis. In: Bernard, T., Mosepele, K. and L. Ramberg (Editors). Environmental Monitoring of Tropical and Subtropical Wetlands. University of Botswana, Maun and University of Florida, Gainesville, FLA. , pp 363–390.

Mosepele, K, Kolding, J., Bokhutlo, T. and Wolski, P (in prep.) Fisheries dynamics in a fluctuating environment: The seasonal flood pulse – a major driver of change in the Okavango Delta's fishery?

Mosepele, K., Mmopelwa, T.G. and Mosepele, B. (2003). Characterization and Monitoring of the Okavango Delta Artisanal Fishery, pp 391–413. In: Bernard, T., Mosepele, K. and L.

Ramberg (Editors). Environmental Monitoring of Tropical and Subtropical Wetlands. University of Botswana, Maun and University of Florida, Gainesville, FLA.

Mosepele, K. and Mosepele, B. (2006). An Analysis of Spatial and Temporal Variations in the Okavango Delta Fishery: Toward the Development of a Fisheries Management Plan. Botswana Notes and Records37: 280-291.

Mosepele, K., Mosepele, B. and Williams, L. (2005a). Preliminary assessment of the feeding ecology of silver catfish (Schilbe intermedius, Ruppel, 1832) in a seasonal floodplain of the Okavango Delta. Botswana Notes and Records, 37: 2008-217.

Mosepele, K., Moyle, P.B., Merron, G.S., Purkey, D.R. and Mosepele, B. (2009). Fish, floods, and ecosystem engineers: aquatic conservation in the Okavango Delta, Botswana. BioScience 59 (1): 53–64.

Mosepele, K. and Nengu, S. (2003). Growth, mortality and length-weight parameters of selected fishes of the Okavango Delta, Botswana. ACP-EU Fisheries Research Report 14: 67-74.

Mosepele, K. and Ngwenya, BN, 2010. Socio-economic survey of commercial fishing in the Okavango Delta, Botswana. Okavango Report Series 7. Harry Oppenheimer Okavango Research Centre, University of Botswana, Maun Campus. 75p.

Mosepele, K., Ngwenya, B.N. and Bernard, T. (2006). Artisanal fishing and food security in the Okavango Delta, Botswana. In: World Sustainable Development Outlook, 2006. Ed A. Ahmed. Science and technology research. Brighton, Interscience Ltd, UK.

Mosepele, K., Onalethata, B., Mosepele, B., and Bokhutlo, T. (2005b). Using population parameters to separate fish stocks in the Okavango Delta fishery: a preliminary assessment. Botswana Notes and Records, 37: 292-305.

Munwela, C. (2010). The assessment of the fishery and the fish stock of the Kavango River in the northeastern Namibia. MSc thesis, University of Free State, 106 pp.

Nengu, S.M. (1995). Status of fisheries in wetlands. In H. H. Masundire, K. N. Eyeson, and S. F. Mphuchane (eds) Wetlands Management in Botswana: Proceedings of a conference held in Kasane, 14-16 November 1994. Wetland Coordinating Committee, Botswana.

Ngwenya, B. N. and Mosepele, K. (2007). HIV/AIDS, artisanal fishing and food security in the Okavango Delta, Botswana. Physics and Chemistry of the Earth, 32: 1339-1349.

Ngwenya, B.N., Mosepele, K. (2008) Socio-Economic Survey of Subsistence Fishing in the Okavango Delta, Botswana. Okavango Report Series No. 6. Harry Oppenheimer Okavango Centre, University of Botswana ISBN 978-99912-463-4-5. p 50.

Njaya, F.J., Donda, S.J. and Hara, M.M. (no date). Fisheries co-management in Malawi: Lake Chiuta re-visit case study. Manuscript.

Njaya, F., Donda, S., Mwambene, C. and Labu, M. (2012). Malawi's co-management situation with relevance to the fisheries of the Zambezi basin: challenges,players, processes

and successes. Presentation In Final Technical Report, Support to the identification phase of the SADC program 'Strengthening co-management and value chains of shared fisheries resources in the Zambezi basin' Project ref. N° SA-1.3-B6, SADC, Botswana, October 2012.

Okavango Crocodile Monitoring Programme (2011). Okavango Panhandle Sanctuary, A Proposal by the Okavango Crocodile Monitoring Programme, 8 pp.

ODMP (2007). ODMP Ngamiland Tourism Development Plan - Final Report Vol. 1-3. A report prepared for the North-west District Council and Department of Tourism.

ODMP (2008). Okavango Delta Management Plan, January, 2008. Dept of Environmental Affairs, Gaborone, 191 pp.

Ramberg, L., Hancock, P., Lindholm, M., Meyer, T., Ringrose, S., Sliva, J., Van As, J. and Van der Post, C. (2006). Species diversity of the Okavango Delta, Botswana. Aquat. Sci. 68(3): 310-337.

Peel, R.A. (2012). The biology and abundance of three cichlid species from the Kavango and Caprivi regions, Namibia. MSc thesis, University of Namibia, 169 pp.

Peel, R.A., Weyl, O.L.F. and Omoregie, E. (2012). Comparative biology of three cichlid species in Lake Liambezi and the Kavango, Kwando and Zambezi river systems to make recommendations for the best source of fingerlings for stocking. Final Report for Integrated Community-Based Ecosystem Management (ICEMA) Project, 24 pp.

Ramberg, L. and van der Waal, B.C.W. (Eds) (1997). Fisheries Management in the Okavango Delta, A Workshop Organized by the Fisheries Section, Ministry of Agriculture. 27-30 January 1997, Maun.

Reed, C.C., Basson, L. and Van As, L.L. (2002). Myxobolus species (Myxozoa), parasites of fishes in the Okavango River and Delta, Botswana, including descriptions of two new species. Folia Parasitol (Praha), 49(2):81-88.

S. Thapelo Attorneys (2008). The creation of a usufruct rights framework for the upper panhandle of the Okavango Delta. A report for the Biokavango Project, Okavango Research Institute, Maun. 109 pp.

Setswalo, O. (2007). Conflicts and conflict resolutions between the local fishers and the tour operators in the upper panhandle of the Okavango Delta in Botswana. Thesis for Diploma in Wildlife Management and Conservation, Botswana Wildlife Training Institute, Department of Wildlife and National Parks, 29 pp.

Shipton, T.A. (2011). The Okavango Delta Fisheries Management Plan Report. Soges SpA, ACP Fish II Coordination Unit Services Contract no CU/PE1/MZ/10/004, 79 pp.

Siziba, N., Chimbari, M.J., Mosepele, K. and Masundire, H. (2011). Spatial and temporal variations in densities of small fishes across different temporary floodplain types of the lower Okavango Delta, Botswana, African Journal of Aquatic Science, 36:3, 309-320.

Skelton, P.H. (2001). A complete guide to the freshwater fishes of southern Africa, Southern Book Publishers (PTY) LTD, Halfway House, 395 pp.

Skelton, P.H. and Merron, G.S. (1984). The fishes of the Okavango River in South West Africa, with reference to the possible impact of the eastern National Water Carrier on fish distribution. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 9: 32 pp.

Skelton, P.H. and Merron, G.S. (1987). A third survey of the fishes of the Okavango River in South West Africa, with reference to the possible impact of the eastern National Water Carrier on fish distribution. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa. Investigational Report No. 24: 21 pp.

Skelton, P.H., Bruton, M.N., Merron, G.S. and van der Waal, B.C.W. (1985). The fishes of the Okavango drainage system in Angola, South West Africa (now Namibia) and Botswana: Taxonomy and distribution. Ichthyological Bulletin. J.L.B Smith Institute of Ichthyology, Grahamstown, South Africa, No. 50. 21 pp.

Skjønsberg, E. and Merafe, Y. (1987). The Okavango fisheries. Socio-economic Study. A report commissioned by the Ministry of Agriculture, Botswana and the Ministry of Development Cooperation, Norway.

Smit, N.J., Davies, A.J. and Van As, J.G. (2000). A trypanosome from silver catfish (Schilbe intermedius) in the Okavango Delta, Botswana. Bulletin of the European Association of Fish Pathology, 20: 116-119.

Smit, N.J., Van As, J.G. and Davies, A.J. (2003). Observations on Babesioma maria (Apicomplexa: Dactylosomatidae) from the Okavango Delta, Botswana. Folia Parasitologica, 50: 85-86.

Smit, N.J., Van As, J.G. and Davies, A.J. (2004). Fish trypanosomes from the Okavango Delta, Botswana. Folia Parasitologica, 51: 299-303.

Soekoe, M., Smit, N.J. and Van der Bank, H. (2009). Low allozyme variation in tigerfish Hydrocynus vittatus (Teleostei: Alestidae) from the Okavango panhandle, with notes on the selection of candidates for artificial breeding. African Journal of Aquatic Science, 34(3): 249–254.

Suski, C.D. and Steven J. Cooke, S.J. (2007). Conservation of aquatic resources through the use of freshwater protected areas: opportunities and challenges. Biodiversity Conservation, 16:2015–2029.

Sweeney, L., Baker, A., Thaniseb, A., Brown, C., Tweddle, D., Hay C. and van der Waal, B. (2010). A preliminary economic assessment of the contribution of fishing lodges in the Caprivi Region to the local economy, April 2010. Integrated Co-management of Zambezi / Chobe River System - Transboundary Fisheries Resource, Namibia / Zambia / Botswana, Technical Report no. MFMR/NNF/WWF/Phase II/1, 21 pp.

Tweddle D., Bills R., van de Waal B., Skelton P., Kolding J. and Nengu S. (2003). Fish Diversity and Fisheries in the Okavango Delta, Botswana. In Alonso L.E. and Nordin L.

(editors). A rapid biological assessment of the aquatic ecosystems of the Okavango Delta, Botswana: High Water Survey. Conservation International, Washington, D.C. RAP Bulletin of Biological Assessment, 27: 97-110 and 210-245.

Tweddle, D., Bills, R., Swartz, E., Coetzer, W., Da Costa, L., Engelbrecht, L., Cambray, J., Marshall, B., Impson, D., Skelton, P.H., Darwall, W.R.T. and Smith, K.G. (2009). Chapter 3. The status and distribution of freshwater fishes. In The Status and Distribution of Freshwater Biodiversity in Southern Africa, edited by Darwall, W.R.T., Smith, K.G., Tweddle, D. and Skelton, P. IUCN, Gland Switzerland and SAIAB, Grahamstown, South Africa, 21-37.

Tweddle, D. and Hay, C.J. (2011a). Recommendations for modifications to the Inland Fisheries Resources Act, 2003 and associated regulations, October 2011. Integrated Co-management of Zambezi/Chobe River System - Transboundary Fisheries Resource, Namibia/Zambia/Botswana, Field Document no. MFMR/NNF/WWF/Phase II/4: 48 pp.

Tweddle, D. and Hay, C.J. (2011b). Fish Protection Areas: Documentation for their establishment in Sikunga and Impalila Conservancies, December 2011. Integrated Co-management of Zambezi/Chobe River System - Transboundary Fisheries Resource, Namibia/Zambia/Botswana, Field Document no. MFMR/NNF/WWF/Phase II/6: 28 pp.

Tweddle, D., Weyl, O.L.F., Hay, C.J., Peel, R.A. and Shapumba, N. (2011). Lake Liambezi, Namibia: fishing community assumes management responsibility, July 2011. Integrated Co-management of Zambezi/Chobe River System - Transboundary Fisheries Resource, Namibia/Zambia/Botswana, Field Document no. MFMR/NNF/WWF/Phase II/4, 17 pp.

Tweddle, D., R.D. Makwinja and G. Sodzapanja (1995). Catch and effort data for the fisheries of the Lower Shire River and associated marshes, 1976-1993. Malawi Fisheries Bulletin, 31:126 pp.

Tweddle, D., Turner, G.F. and Seisay, M. (1995). Changes in species composition and abundance as a consequence of fishing pressure in Lake Malombe, Malawi. In The impact of species changes in African lakes, edited by Pitcher, T.J. and Hart, P.J.B. Chapman and Hall, London, 413-424.

Tweddle, D. and Wise, R.M. (2007). Nile Tilapia (Oreochromis niloticus). In Wise, R.M., van Wilgen, B.W., Hill, M.P., Schulthess, F., Tweddle, D., Chabi-Olay, A. and Zimmerman, H.G. (2007). The economic impact and appropriate management of selected invasive alien species on the African continent. Final Report prepared for the Global Invasive Species Programme. CSIR Report Number CSIR/NRE/RBSD/ER/2007/0044/C, Appendix 3: 43 pp.

Van der Bank, H. and Smit, N. (2007). Large allozyme variations within populations and isozyme differences between Clarias gariepinus and C. ngamensis from the Okavango Delta, Botswana. African Journal of Aquatic Science, 32(3): 311-315.

Van der Bank, F.H., Wink, M., Soekoe, M. and Smit, N. (2009). Does Serranochromis altus (Teleostei: Cichlidae) exist in the Okavango Delta, Botswana? African Journal of Aquatic Science, 34(1): 57-68.

Welcomme, R.L. (1985). River fisheries. FAO Fisheries Technical Paper no 262: 310 pp.

Welcomme, R.L. (1991). Inland fisheries: ecology and management. Blackwell, Oxford.

PART B: COMPONENTS OF THE TRANSBOUNDARY FISHERIES MANAGEMENT PLAN

GUIDELINES FOR CO-MANAGEMENT

Key: Learn From Successes and Failures Elsewhere

Lessons

- Co-management of natural resources can only succeed from the start where there are still resources worth protecting.
- If resources are severely degraded, there needs to be an alternative approach to restore health of ecosystem services before embarking on co-management. Outside help may be needed.
- Environmental education is essential at all levels from schoolchildren upward; communities need to be fully informed of fisheries issues, very basic fish biology, regulations, etc.
- Fisheries committees for co-management should be set up only after very careful and detailed consultation with all stakeholders.
- Committees should be formed/elected by the communities themselves, but there needs to be an effort to ensure that all levels of community structure are represented on committees, with an emphasis on fishers' representatives.
- If the resource is shared by different communities, ensure that all are fully represented on the committee, or have a central coordinating committee composed of key members of separate village committees.
- Learn from already successful community-based programs through exchange visits between communities and other stakeholders.
- Fisheries departments' role is primarily education, supporting communities in decision-making, endorsing locally agreed upon bylaws when appropriate, advising against inappropriate, unsustainable activities, etc.

Responsible Organizations for Implementation of Co-Management on the System:

- Government departments with fisheries responsibilities for the Cubango/Okavango Fisheries
- Regional Councils
- Traditional Authorities

Contributing Organizations for Implementation of Co-Management Systems:

- SAREP
- EU fisheries project
- ORI
- KAZA
- OKACOM
- INIP
- IPA
- MINAMB

Actions for Implementation Under Management Plan, by Responsible and Contributing Organizations:

- Development of teaching materials.
- Cross-border dissemination of experiences, e.g., taking community members to other fishery areas to observe co-management in operation and share information on what systems work and why, etc.
- Identification of potential areas for co-management through stakeholder consultation and identification of potential for differing exploitation patterns of fisheries resources.
- Assistance in establishing fishers' committees and support through formative years.
- Support for locally agreed upon bylaws if appropriate scientifically and socially.

PROPOSAL FOR ESTABLISHING FISH PROTECTION AREAS

Namibia

Different approaches are possible to set up FPAs along the Kavango River in Namibia. In terms of this transboundary management plan, we highlight two initial possibilities that can be investigated through the EU project and other potential programs.
The first is related to the current proposal being prepared for recognition of Mahango National Park as a RAMSAR site. The planning for this is in its initial stages, during which discussions are taking place about the potential for surrounding areas to be included in the program. A possibility being explored is for the communities immediately to the north of the park to establish FPAs between Mahango and Divundu, where the tourist lodges that are the major contributors to the local economy can develop agreements with the communities for catch and release angling, following the Caprivi model.

The second possibility is for the three conservancies along or near the river to expand their natural resource management activities to the river, and establish FPAs in their areas of jurisdiction.

Botswana

In the literature review for this document, the Phillipo Channel has been highlighted as a key area for crocodile conservation, with the potential for it to be included as a protected area for other fauna and flora. This could include either some, or all, of the channel being established as a FPA. This management plan recommends that the potential of the Phillipo Channel should be thoroughly explored through a joint task force of key stakeholders, including, but not restricted to, the Department of Wildlife and National Parks (wildlife and fisheries divisions), Tourism, and Ministries with responsibilities for rural affairs. The mandate for this joint task force will be to determine the impacts that establishment of a protected area or areas will have on the communities, and the potential for deriving benefits for the communities from tourism in the channel. During the scoping workshop, it was suggested that different communities may have interests in the natural resources of the channel and therefore there is scope for conflict, hence the need for the task force to thoroughly investigate all potential issues.

The Phillipo Channel is one suggested potential site for an FPA, but there are numerous other smaller potential sites throughout the Panhandle and in the Delta. The key criteria for setting up FPAs, as listed above, are size, biological suitability, ability to control, ensuring that local fishers would not be disenfranchised, and potential for earning revenue from tourism

primarily through fee-paying catch-and-release angling. Exploratory discussions with communities in the area are recommended in this management plan. The steering committee for the management plan should identify key partners to initiate this process.

Angola

At this stage in the management plan development, we are not in a position to make recommendations or suggestions, particularly as (a) tourism in the Cubango catchment area in Angola has not yet developed, and (b) we are uncertain about human population densities and fishing effort and thus cannot comment on the potential benefits of breeding sanctuaries. Instead, we concentrate on those parts of Botswana and Namibia that can benefit from FPAs and note that the successes and/or failures can serve as models for development of FPAs in Angola in the future. Areas along the international border between Namibia and Angola may be identified as potential sites for FPAs stretching across the river, benefitting both Namibia and Angola.

OUTPUTS TO BE ACHIEVED

Sampling Strategy

- The following templates are attached as Appendix 6.

  - Biological survey form
  - Habitat description form
  - Catch assessment survey form
  - Fisheries data bulk recording form
  - Fish market survey form
  - Recreational fishing survey form
  - Frame survey form
  - Water chemistry form

Recommended Analysis to be Done

- The following analysis should form the basis to work from:

  - Length at maturity for individual species (biological data)
  - Age and growth of commercially important species (biological data)
  - Breeding habitats (biological data)
  - Nursery habitats (biological data)
  - Length frequencies for individual species (biological, recreational, subsistence, and commercial data)
  - Index of relative importance (biological, recreational, subsistence, and commercial data)
  - Species diversity and composition (biological, recreational, subsistence, and commercial data)
  - Sampling gear selectivity (biological, subsistence, and commercial data);
  - Migration behavior (biological data)
  - Habitat preferences (including water quality) (biological data)
  - Food preferences and food webs (biological data)

- Abundance (biological, subsistence, and commercial data)
- Catch per unit effort (biological, subsistence, and commercial data)
- Population structure (biological, subsistence, and commercial data)

- Historical data of life history parameters of commercially important species to be reviewed
- Key species to be identified and age, growth and maturity at age and size determined using otoliths at selected areas throughout the river system
- Life history information to be translated into management actions/plans

Proposed Sampling Equipment to Ensure Standardized Surveys

Gill Nets

Main sampling gear should be gill nets, supplemented by a wide range of sampling gear types to limit gear selectivity and to sample all habitat types.

- Brown multi-filament nets with stretch mesh sizes ranging from 12 to 150 mm (i.e., 12, 16, 22, 28, 35, 45, 57, 73, 93, 118 and 150 mm).
- Eleven (11) mesh panels randomly joined to form one set. Each mesh panel is 10 m in length and approximately 2 to 3m in depth.
- Three to four sets are set per site, depending on the habitat types.
- It is important to have a high effort (number of gill net sets) at each site to ensure a representative sample.
- The nets (sets) are between 18:00 hrs in the evening and 06:00 hrs the next morning.
- Gill nets are set at same locality if possible during each survey. Variable water level may cause sites to change with season.
- The gill nets are used to survey open, deep-water habitats in main stream near the shore and deep backwater areas with some aquatic vegetation. Gill nets are set either in the middle of water bodies or near marginal vegetation.
- Gill nets play an important role in identifying trends with time.

Other Supplemental Gear

Other gears are used at or close to gill net localities. These target small species and juveniles of long-lived species in shallow, vegetated, and rocky habitats. Use of other gears is subject to type of habitats present at sites.

Rotenone. The piscicide rotenone is used to survey habitats where other fishing methods are impractical or inefficient, including rocky rapids and dense aquatic vegetation. Rotenone should be used only by trained operatives due to dangers associated with using toxic chemicals.

Drag nets. These are 10- to 30-meter seine nets with a depth of 1.5-2.0 m, made from green anchovy net with stretched mesh of 12 mm. They are operated in large open water bodies with very little water flow. Drag nets are used to sample shallow habitats such as backwaters,

bays, and main streams with sandy or muddy substrates. They are occasionally used within aquatic vegetation.

D-net. D-nets are used in vegetated habitats and in shallow water with sandy substrates. They are used in sandy habitats by removing top layer of sand.

Cast net. This is a 2-m cast (monofilament nylon twine) net with a 20-mm stretched mesh used to collect fish from deep-water habitats in backwaters and main stream. Can be used in slow, fast, or deep flowing areas.

Electric fisher. Polish-made Samus backpack electric fishers are useful for sampling a wide variety of habitats, particular rocky rapids and vegetation fringes of rivers. They are used in conjunction with other gears, particularly D-nets, where the electric current is used to drive fish out of cover and into the waiting net.

Traps. Conical-shaped traps are made from wire with 2-mm mesh size. They are placed near the shore in shallow, strong water currents and within aquatic vegetation.

Rod and reel/long line. Angling with a rod and reel (including long lines) is an important tool to catch larger fish. Long lines target catfishes that may be under sampled using only gill nets.

Stations to be Sampled

Botswana

- Seronga
- Ngalange
- Guma
- Samochima

Namibia (to continue at existing sites that they have been sampling)

- Nkurenkuru
- Musese
- Rundu
- Cuito
- Kwetze

Angola (to combine with Namibia until resources and manpower improve)

- Savate
- Caiundo
- Calai

Stations should represent river section of that particular country and a wide variety of habitats in that area. If possible one protected area should be included to serve as potential reference point. Only two stations per country are to be surveyed during this program, to reduce cost. More stations could be surveyed by individual countries after this program comes to an end, still forming part of the standardization process.

Survey Frequencies and Timeframe

- Initially, as part of this program, two surveys should be conducted, one each during a high water (March/April) and a low water (September/October) period.

- A core survey team (consisting of 6 scientists, two from each country) is to undertake these two surveys.
- Additional people will join each survey when done in that particular country. This will facilitate capacity building within each country with a larger number of scientists being trained.
- The core team will move to next country and train further additional people. Each country is to decide on number of additional people to be trained.
- Decision to be taken when surveys will take place. Earlier indication was between end of July and end of October 2013.
- Surveys will include biological, catch assessment, fish market, and frame surveys done concurrently during the two survey periods.
- Frame survey will be carried out during the first survey period and then only to be repeated every three to five years by each country separately.
- Biological surveys should continue (after the termination of the program) at each station as identified, conducted during high and low water period by each individual country using standardized research methodology as developed.
- The catch assessment surveys should be community based, and local community members should be trained in data collection. Data should be collected on a bi-weekly basis.
- Namibia, where process is successful in Caprivi region, should assist in in-service training of community members. Visits to conservancies should be arranged for community members to witness the benefits accrued by these communities/conservancies.
- The major fish markets in each country should be surveyed bi-weekly.
- Owners/managers from fishing lodges must be identified to take part in data collection from their clients practicing catch-and-release.
- A focal person from each country should be identified to liaise with fishing lodges to collect data forms to be processed.
- Sensitization of communities before the surveys starts to establish trust and to gain support for these initiatives.

Logistics for Surveys

The following points should be considered:

- Fuel funds; stipend required to be used for vehicles
- Subsistence and travel allowances
- Focal points to buy four nets per country. D-nets, electro-shocker
- PH, temperature and turbidity of water testing methods (provision of multi-meter)
- Botswana committed to supply two boats, two vehicles, and camping gear
- Angola committed to supply two boats
- Namibia committed to supply one boat and one vehicle
- Additional funding needed for stationery

Setting Up a Steering Committee

- Responsibility to execute successful implementation of the program. Consists of the following government officials from each country: One person from management and two scientists.
- The committee can co-opt experts forming a sub-committee/working group to study a particular aspect.
- The following people were nominated as the focal person and will form part of the steering committee:
  - Mr. Isaac Batsile (Botswana)
  - Mr. Munwela (Namibia)
  - Mr. De Almeida (Angola)
- The chair and venue for meetings is to rotate annually.
- Meetings to be held at least once a year.
- Proposed Terms of Reference for the steering committee:
  - Development of a program for joint surveys.
  - Responsible for the timely execution of monitoring surveys.
  - Responsible for establishment and maintenance of shared databases.
  - Development of a data protocol.
  - Responsible for producing research reports and efficient flow of results to management for integration into management policies/actions.
  - Identify research gaps to be addressed, either by fisheries departments or tertiary institutions.
  - Identify training needs and develop a training strategy to ensure future qualified and experienced scientists.
  - Ensure that the harmonization of legislation and standardization of research methodologies continue.
  - Responsible for efficient communication between all stakeholders.
  - Ensure that the program becomes sustainable and fully supported by governments with necessary financial and manpower resources and infrastructure.
- The steering committee should report back to the fisheries departments from the three countries, to the JPCC (Namibia/Botswana) and to OKACOM.

Early Warning System for the Outbreak of Disease and the Presence of Alien/Exotic Fish Species in the System to be Developed

- The World Organisation for Animal Health (OIE) Regional Workshop on OIE standards held in Mozambique in 2008 recommended the following related to disease:

  - Promote dialogue between veterinary authorities and other competent authorities, as well as the private sector, to identify their respective roles and responsibilities with respect to aquatic animal health matters
  - Review national legislative framework for allowing development of fisheries and aquaculture sector
  - Prioritize aquatic animal diseases of concern and fast tracking implementation of surveillance programs

- Enhance cross-border cooperation between competent authorities to control aquatic animal diseases
- Coordinate and support establishment of regional aquatic animal health network for fisheries and aquaculture in southern Africa with relevant bodies at national, regional, and international levels

- Refer to the Aquatic Animal Health Code (2012) for more detail.

- The following steps are recommended to monitor alien species:

  - Tissue sampling for DNA bank should form part of monitoring process.
  - Digital photo of specimens.
  - Specimens preserved in 10 percent formaldehyde and send to SAIAB for identification purposes.

- Detailed reports on disease or alien species circulated to steering committee and other countries.

Development of Shared Databases

Following shared databases to be developed:

- Biological database
- Catch assessment database for subsistence and commercial fishery
- Recreational fishery database
- Frame survey database
- Fish market database
- Water chemistry database

Compilation of an inventory of all available data listing the following:

- Data format (all databases)
- Sampling frequency (sampling dates, all databases)
- Sampling gear used (biological, catch assessment, and water chemistry)
- Localities sampled (GPS coordinates, all databases)
- Variables recorded (all databases)
- Total number of fish sampled (biological)

Steering committee should take responsibility for developing of database protocol. Protocol should provide the following:

- Guidelines for the usage and storage of the different databases
- Identify institutions responsible for updating, data cleaning, storage and general maintenance for all databases, including hard copies of all recorded data.

Protocol to be endorsed as an official document by all countries.
The following software packages are recommended:

- PASGEAR 2
- Microsoft Office Excel
- Statistical Package for the Social Sciences (SPSS)

The setup of these databases could initially be outsourced.

Joint Patrols (Namibia and Angola)

- The section of the river bordering Namibia and Angola should be regularly patrolled jointly by both countries.
- The frequency should be deliberated on between the two fisheries departments.
- Patrols should be done where possible in collaboration with Immigration and the Police.
- Patrol reports should be drafted and forwarded to the steering committee and to the two fisheries departments.
- Data should be entered into the shared database.

ESTABLISHMENT OF A STEERING COMMITTEE

The authors of this management plan recommend setting up a joint steering committee, officially endorsed by all three countries, to:

- Strengthen collaboration and communication on a technical level
- Prepare the budget needed to implement the plan
- Approve the research and monitoring programs to be conducted
- Ensure that collaboration and monitoring programs continue after this project and are sustainable considering future resources and infrastructure

Appendix 3 provides a table of the issues to be considered by the steering committee in the harmonization of policy and legislation, while Appendix 4 gives an overview of arguments for and against the establishment and harmonization of a closed season in the three countries.

*For all annexes referred to in the table of contents and throughout this report, please see SAREP Technical Series – Volume 2b: Annexes to A Transboundary Fisheries Management Plan for the Okavango/ Kavango/ Cubango Basin